

# INITIAL CORE DESCRIPTIONS

DEEP SEA DRILLING PROJECT  
LEG 47A OFFSHORE NW AFRICA  
LEG 47B OFFSHORE PORTUGAL



Prepared for the  
NATIONAL SCIENCE FOUNDATION  
National Ocean Sediment Coring Program  
Under Contract C-482  
By the  
UNIVERSITY OF CALIFORNIA  
Scripps Institution of Oceanography  
Prime Contractor for the Project

# UNIVERSITY OF CALIFORNIA, SAN DIEGO

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SCRIPPS INSTITUTION OF OCEANOGRAPHY

POST OFFICE BOX 1529  
LA JOLLA, CALIFORNIA 92093

Dear Colleague:

This document has been printed and distributed by the Deep Sea Drilling Project for the purpose of sample selection by interested earth scientists. Sample requests are honored after one year following completion of the cruise on which the samples were collected. It is an interim and informal document consisting of site data and sedimentologic and paleontologic data and interpretations as known six (6) months post-cruise. These data, while adequate for most sample selection needs, are subject to slight revision by the time of issue of the corresponding volume of the Initial Reports of the Deep Sea Drilling Project.

The information contained herein is preliminary and privileged, consequently this document is not to be cited or used as the basis of other publications. Data cited or used in a manuscript will be considered a breach of professional ethics.

Thank you for your interest in the Deep Sea Drilling Project.

Sincerely,

A handwritten signature in cursive script that appears to read "David G. Moore".

David G. Moore  
Chief Scientist  
Deep Sea Drilling Project

# INITIAL CORE DESCRIPTIONS

## DEEP SEA DRILLING PROJECT

### LEG 47A

20 March — 12 April 1976

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A Project Planned by and Carried Out With the Advice of the  
JOINT OCEANOGRAPHIC INSTITUTIONS FOR DEEP EARTH SAMPLING (JOIDES)

#### MEMBER ORGANIZATIONS

Institute of Geophysics, University of Hawaii  
Lamont-Doherty Geological Observatory, Columbia University  
School of Oceanography, Oregon State University  
Graduate School of Oceanography, University of Rhode Island  
Rosenstiel School of Marine and Atmospheric Sciences, University of Miami  
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Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover  
Ocean Research Institute, University of Tokyo  
USSR Academy of Sciences, P. P. Shirshov Institute of Oceanology, Moscow

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#### PARTICIPATING SCIENTISTS

William Ryan, Ulrich von Rad, Michael Arthur, Pavel Cepek,  
Maria B. Cita, Christopher Cornford, Linda Garifal,  
N. Hamilton, I. S. Lopatin, G. F. Lutze,  
Floyd McCov, Greg Mountain, Michael Sarnthein.

*Glomar Challenger* departed from Las Palmas (Gran Canaria, Canary Islands) on 20 March 1976, drilled two holes at Site 397 (see Figure 1), and arrived at Vigo (Spain) on 12 April 1976.

The major objective of Leg 47A was to decipher the complex Cretaceous and Tertiary history of a flexured passive continental margin, for which the West Saharan segment between the Requibat Uplift (Cape Blanc) and the Canary Islands (Cape Juby) is a good example. The subsiding edge of this margin has experienced major episodes of erosion, non-deposition and redeposition, especially during two major regressions (mid-Cretaceous and mid-Tertiary). The thick wedge of uppermost continental rise sediments off NW Africa had never before been penetrated beyond the Neogene (DSDP Site 139). DSDP Site 369, on the continental slope nearby, served as an ideal companion site of our proposed drilling program for rise-slope comparisons. The planned site was expected to allow a better reconstruction of the history of uplift and subsidence, transgressions and regressions, mechanics of deposition and erosion during Early Cretaceous to Neogene time.

### Results

The anticipated stratigraphy of Site 397 was based on the interpretation of reflectors D<sub>1</sub> (as mid-Cretaceous to Eocene) and D<sub>2</sub> (as Oligocene-early Miocene), and on previous drilling (Site 369) and pre-site surveys. The fact that 1300 meters of Miocene had to be drilled before Mesozoic strata were reached, changed our original objectives and provided new insights to the solution of many questions concerning the structure and stratigraphy of passive continental margins. Based on the revised stratigraphy and on seismic data, at least 4500 meters of Jurassic to Valanginian sediments remain unpenetrated at our drill site.

The oldest strata encountered at this site (Figure 2) are a 153 meter Valanginian/mid-Hauterivian interval of finely laminated, dark-gray quartzose mudstone with numerous thin dolomicrite intercalations. The mudstones are an enigmatic facies posing a number of interrelated sedimentary and paleoenvironmental problems which include depth and environment of deposition.

Tentatively, a marine prodeltaic (delta-slope) or a distal fan environment is suggested. A slope setting is indicated by slump structures, contorted laminations and consistently high dipping laminations. A distal setting is indicated by the dominance of the clay fraction, paucity of recognizable turbidites, and the abundance of plant fragments and micas. The equivalent Lower Cretaceous sections of the onshore Tarfaya and Aaiun Basins consist of thick non-marine sandy to conglomeratic sequences, which might represent the landward continuation of the

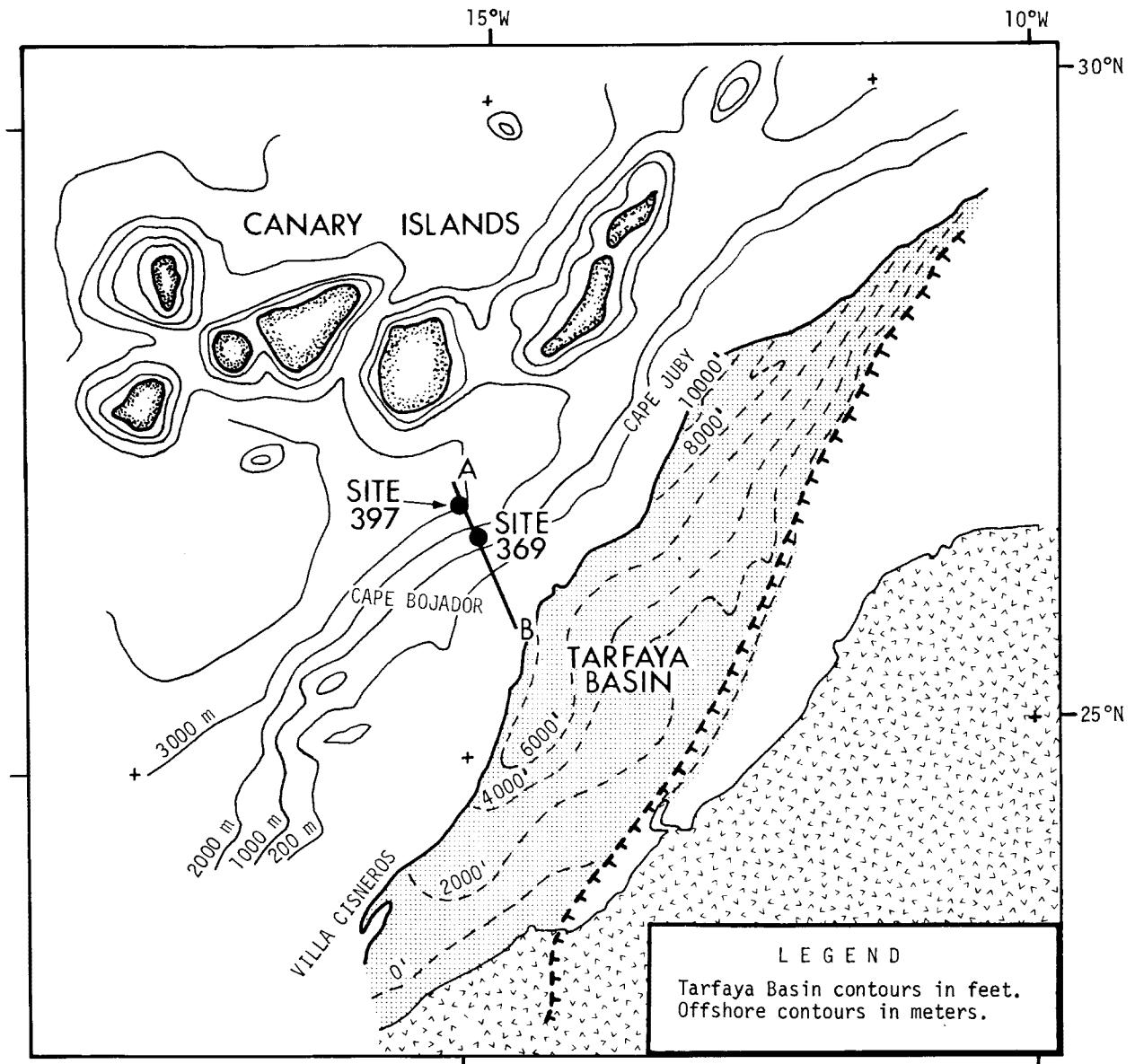


FIGURE 1. Topography near Site 397 with sediment isopachs for onshore portion of Tarfaya Basin.

S I T E   3 9 7

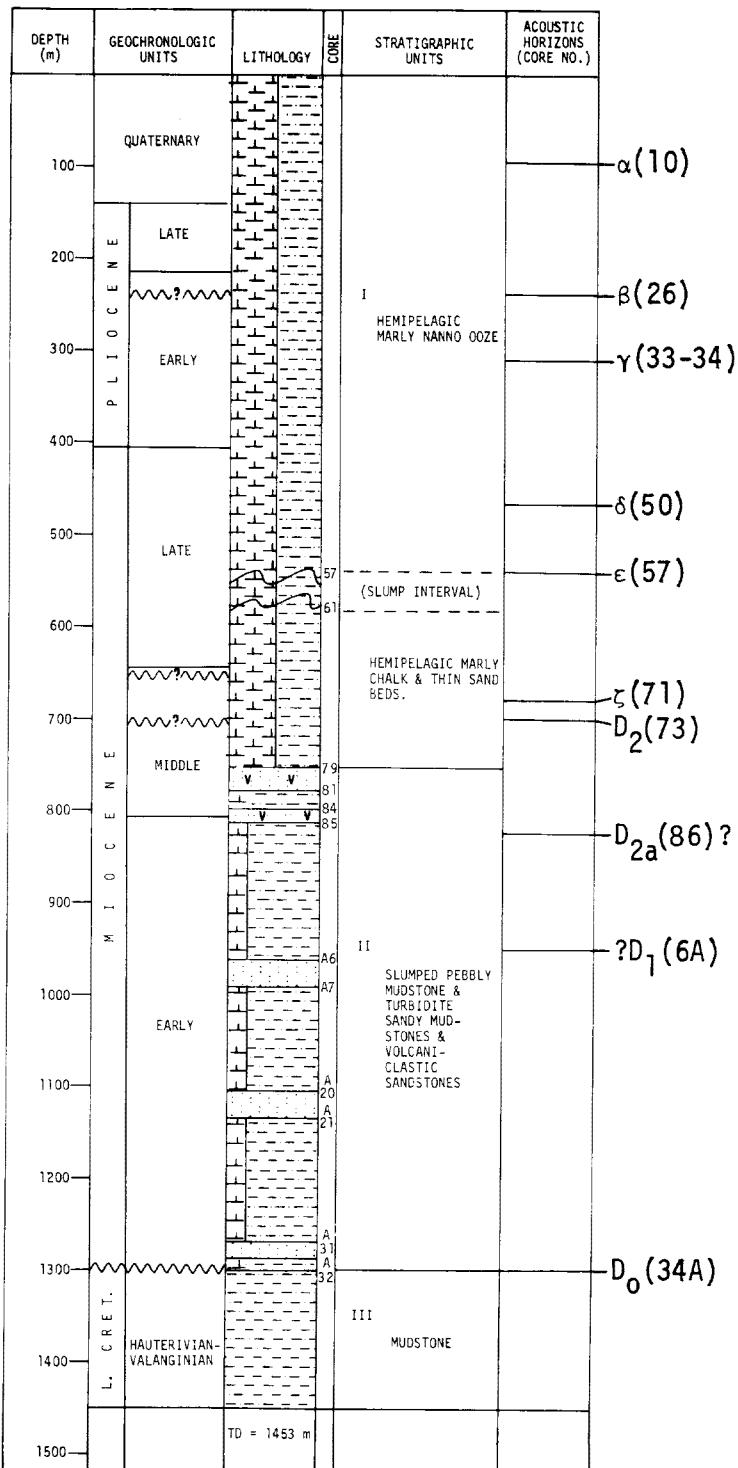


FIGURE 2 Litho-bio-acoustostratigraphy at Site 397.

same deltaic setting.

A 100 to 110 m.y. hiatus separates the Middle Hauterivian interval from overlying earliest Miocene rocks penetrated at 1300 meters. Such a large gap allows only tentative interpretations on the dating and processes of destruction of the continental slope and rise. Possibly this erosion was caused by geostrophic contour-following bottom currents enhanced by the late Oligocene initiation of the strong circum-Antarctic bottom water circulation after the separation of Australia from Antarctica. A vast amount of sediment, conceivably  $>10^4 \text{ km}^3$ , was probably removed from this ancient and formerly prograding Mesozoic continental slope by one or more mass wasting events. This may have resulted in the back-cutting of an exaggerated 1 to 3 km deep escarpment into the Mesozoic continental margin. In this manner the gradient and instability of the slope were further increased.

Above the hiatus (Figure 2) is a rapidly deposited mostly allochthonous sequence. It consists of 550 meters of slump masses, debris flows, turbid layer sediments and turbidites which followed the major pre-Miocene erosional event and finally re-established an equilibrium gradient from the shelf to the continental rise. About 80 to 90 percent of the sediment section, deposited at a rapid sedimentation rate (up to 200 m/m.y.), contains "allochthonous" lithotypes. Only 10 to 20 percent consists of highly burrowed, more slowly deposited, hemipelagic foraminiferal nanno limestones.

Within this lithologic unit are several thick volcanioclastic tuffaceous sandstones and partly graded conglomerates which were deposited about 16 m.y.B.P. These were probably derived from the Canary Province as debris flows. The flows are contemporaneous with or predate the earliest shield-building phase known from Gran Canaria and Fuerteventura (13-14 m.y.B.P.) and might mark the earliest datable record of volcanic activity.

The youngest strata (Figure 2) are a Late Miocene to Quaternary sequence of hemipelagic marls, chalcs, calcareous oozes and slumped deposits.

The partially siliceous calcareous oozes of this unit were rapidly deposited (50-80 m/m.y.) under conditions of high fertility (upwelling!) and good ventilation. Because of the high sedimentation rates, excellent fossil preservation and the lack of coarse-grained terrigenous input and any major hiatuses, this continuously cored section may permit a substantial refinement of planktonic foraminiferal and nannoplankton stratigraphy, as well as of magnetostratigraphy. Detailed paleomagnetic measurements revealed an alternating sequence of normal and reversed polarity intervals from the Brunhes Epoch to Epoch 6. Dissolution pulses noted in the uppermost Miocene sediments might reflect a rise of the CCD during the Messinian "salinity crisis". Scouring hiatuses at 3.0 and 0.9 m.y. can be tentatively correlated with known periods of intensification of the northern hemisphere oceanic circulation due to glacial

cooling and to an erosional event and transgression approximately 3 m.y. B.P. on Gran Canaria.

This continuously cored very deep continental margin hole will prove ideal for various studies on the diagenetic behavior of carbonates, clay, silica, and especially organic matter. Relatively organic-rich sediments derived from the oxygen-depleted upper slope regime were placed and preserved by the slumping mechanism, and thereby evaded biochemical degradation in the oxygenated deeper waters. This is an important aspect for the prospecting of hydrocarbons in the rapidly deposited flyschoid sediments of the upper continental rise. Methane and trace quantities of C<sub>2</sub> to C<sub>5</sub> hydrocarbons, generated partly by poorly understood low temperature diagenetic processes, were found and continuously monitored as a safety measure. Although no evidence of hazardous hydrocarbon accumulations or source beds was found, preferential diffusion and compaction migration of C<sub>2</sub> to C<sub>5</sub> gases apparently is taking place to a greater degree than was anticipated prior to drilling.

## EXPLANATORY NOTES

### Introduction

Persons wishing to obtain samples are directed to the DSDP-NSF sample distribution policy (reproduced herein, p. 17). Sample requests must be submitted on standard DSDP request forms which may be obtained from:

The Curator  
Deep Sea Drilling Project A-031  
University of California, San Diego  
La Jolla, California 92093

The following material is intended as an aid in understanding:

- (1) the terminology, labeling, and numbering conventions used by the Deep Sea Drilling Project;
- (2) the sediment classification and biostratigraphic framework used on Leg 47A; and
- (3) the presentation of the lithologic and paleontologic data on the core forms which make up much of this publication.

### Numbering of Sites, Hole, Cores, Samples

Drill site numbers run consecutively from the first site drilled by *Glomar Challenger* in 1968; the site number is thus unique. A site refers to the hole or holes drilled from one acoustic positioning beacon. Several holes may be drilled at a single locality by pulling the drill string above the sea floor ("mud line") and offsetting the ship some distance (usually 100 meters or more) from the previous hole.

The first (or only) hole drilled at a site takes the site number. Additional holes at the same site are further distinguished by a letter suffix. The first hole has only the site number; the second has the site number with suffix A; the third has the site number with suffix B; and so forth. It is important, for sampling purposes, to distinguish the holes drilled at a site, since recovered sediments or rocks usually do not come from equivalent positions in the stratigraphic column at different holes.

Cores are numbered sequentially from the top down. In the ideal case, they consist of 9.3 meters of sediment or rock in a plastic liner of 6.6 cm diameter. In addition, a short sample is obtained from the core catcher (a multi-fingered device at the bottom of the core barrel which prevents cored materials from sliding out during core-barrel

recovery). This usually amounts to about 0.2 meters of sediment or rock. During Leg 47A the core catcher sample was split, described, and stored along with the rest of the core, if at all possible, taking care to maintain its proper vertical orientation. This sample represents the lowest stratum recovered in a particular cored interval.

The cored interval is the interval in meters below the sea floor measured from the point at which coring for a particular core was started to the point at which it was terminated. This interval is generally 9.5 meters (nominal length of a core barrel) but may be shorter if conditions dictate. The interval can also be longer if the core barrel was placed in the drill string during a long drilling interval. On Leg 47A almost all core intervals were 9.5 meters, because the drilling program called for nearly continuous coring.

When a core is brought aboard the *Glomar Challenger* it is labeled and the plastic liner and core cut into 1.5-meter sections. A full, 9.5-meter core would thus consist of six sections full and one 0.5-meter section numbered from the top down, 1 to 7. (Section 7 would consist of 0.3 meters of the lowermost sediment from the plastic liner plus the 0.2 meters of core catcher material.) The procedure for labeling both full and partially full cores is shown on Figure 3.

In the core laboratory on the *Glomar Challenger*, after routine processing, the 1.5-meter sections of sediment core and liner are split in half lengthwise. One half is designated the "archive" half, which is described by the shipboard geologists, and photographed; and the other is the "working" half, which is sampled by the shipboard sedimentologists and paleontologists for further shipboard and shore-based analysis.

Samples taken from core sections are designated by the interval in centimeters from the top of the core section from which the sample was extracted; the sample size, in CC, is also given. Thus, a full sample designation would consist of the following information:

Leg (Optional)  
Site (Hole, if other than first hole)  
Core Number  
Section Number  
Interval in centimeters from top of section

Site 397A-11-3, 122-124 cm (10cc) designates a 10cc sample taken from Section 3 of Core 11 from the second hole drilled at Site 397. The depth below the sea floor for this sample would then be the depth to the top of the cored interval (1020.5 meters in the example above) plus 3 meters for Sections 1 and 2, plus 1.22 meters (depth below the top of Section 3), or 1024.7 meters. Note, however, that subsequent sample requests should refer to a specific interval within a core section (in centimeters) rather than depth in meters below the sea floor.

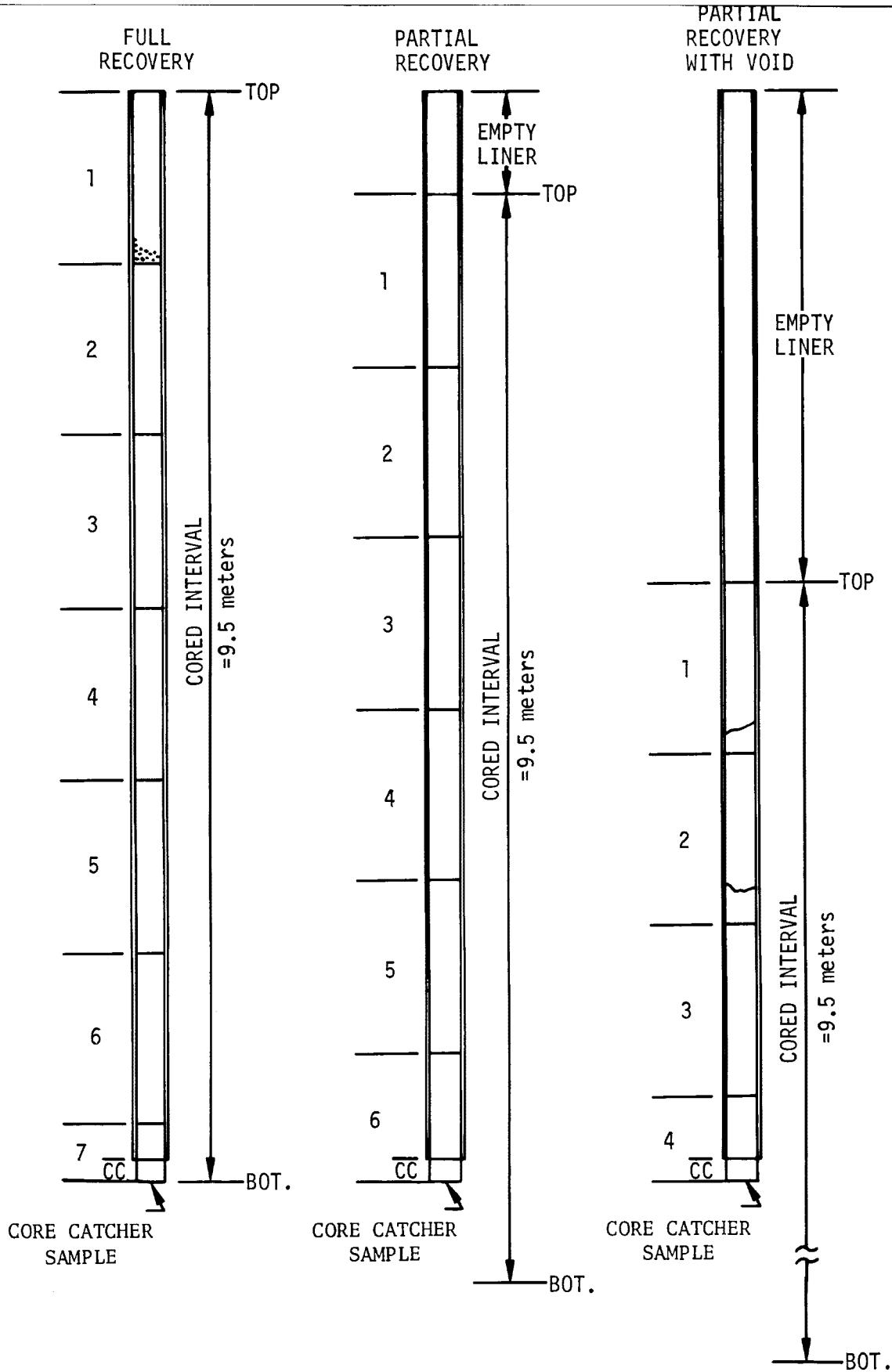


FIGURE 3. Diagram showing procedure in cutting and labeling of core sections.

### Core Disturbance

Unconsolidated sediments are often quite disturbed by the rotary drilling/coring technique, and there is a complete gradation of disturbance style with increasing sediment induration. An assessment of degree and style of drilling deformation is made on board ship for all cored material, and shown graphically on the core description sheets. The following symbols are used:

- | Slightly deformed; bedding contacts slight bend.
- | Moderately deformed; bedding contacts have undergone extreme bowing.
- W Highly deformed; bedding completely disturbed, often showing symmetrical diapir-like structures.
- o Soupy, or drilling breccia; water-saturated intervals that have lost all aspects of original bedding and sediment cohesiveness.
- o Biscuit structure; a drilling "breccia" wherein the broken core material retains some or all aspects of original bedding.

Consolidated sediments and rocks seldom show much internal deformation, but are usually broken by drilling into cylindrical pieces of varying length. There is frequently no indication if adjacent pieces in the core liner are actually contiguous or if intervening sediment has been lost during drilling.

### Smear Slides

The lithologic classification of sediments is based on visual estimates of texture and composition in smear slides made on board ship. These estimates are of areal abundances on the slide and may differ somewhat from the more accurate laboratory analyses of grain size, carbonate content, and mineralogy. Experience has shown that distinctive minor components can be accurately estimated ( $\pm 1$  or 2%), but that an accuracy of  $\pm 10\%$  for major constituents is more common. Carbonate content is especially difficult to estimate in smear slides, as is the amount of clay present. Smear slide analyses at selected levels as well as averaged analyses for intervals of uniform lithology are given on the core description sheets.

### Carbonate Data

During Leg 47A, extensive use was made of the carbonate bomb device as an aid in sediment classification. This device is basically a cylindrical vessel with pressure gauge in which a sediment sample of known weight is reacted with acid. The pressure of  $\text{CO}_2$  generated is

measured and converted to percent carbonate. Accuracy to within  $\pm 5\%$  total carbonate has been quoted for the device. Shipboard carbonate bomb data are listed on the core description sheet.

Samples were taken for DSDP shore-based carbon-carbonate analysis using the LECO 70-second Analyzer. These and organic carbon values are also listed on the core description sheet.

The carbonate bomb and LECO data was used to update the carbonate content (mostly shown as nannofossil, foraminifera or limestone) depicted in the graphic lithology column. No attempt was made to adjust smear slide estimates or sediment names to reflect this correction.

#### Sediment Induration

The determination of induration is highly subjective, but field geologists have successfully made similar distinctions for many years. The criteria of Moberly and Heath (1971) are used for calcareous deposits; subjective estimate or behavior in core cutting is used for others.

##### a) Calcareous sediments

Soft: Oozes have little strength and are readily deformed under the finger or the broad blade of a spatula.

Firm: Chalks are partly indurated oozes; they are friable limestones that are readily deformed under the fingernail or the edge of a spatula blade.

Hard: Cemented rocks are termed limestones.

##### b) The following criteria are used for other sediments:

If the material is soft enough that the core can be split with a wire cutter, the sediment name only is used (e.g. silty clay; sand).

If the core must be cut on the band saw or diamond saw, the suffix "stone" is used (e.g. silty clay-stone; sandstone).

#### Sediment Classification

The sediment classification scheme used on Leg 47A is basically that devised by the JOIDES Panel on Sedimentary Petrology and Physically Properties and adopted for use by the JOIDES Planning Committee in March, 1974, with minor modifications. The classification is outlined below.

I General rules for class limits and order of components in a sediment name.

- A. Sediment assumes the names of those components present only in quantities greater than 15%.
- B. Where more than one component is present, the component in greatest abundance is listed farthest to the right, and other components are listed progressively to the left in order of decreasing abundance.
- C. The class limits are based on percentage intervals given below for various sediment types.

II Pelagic clay

>10% authigenic components  
<30% siliceous microfossils  
<30%  $\text{CaCO}_3$   
<30% terrigenous components

III Pelagic Siliceous Biogenic Sediments

>30% siliceous microfossils  
<30%  $\text{CaCO}_3$   
<30% terrigenous components (mud)

Radiolaria dominant: radiolarian ooze (or radiolarite).

Diatoms dominant: diatom ooze (or diatomite).

Sponge spicules dominant: sponge spicule ooze (or spiculite).

Where uncertain: siliceous (biogenic) ooze (or chert, porcellanite).

When containing 10-30%  $\text{CaCO}_3$ : modified by nannofossil---, foraminiferal---, calcareous---, nannofossil-foraminiferal---, or foraminiferal-nannofossil---, depending upon kind and quantity of  $\text{CaCO}_3$  component.

IV Transitional Biogenic Siliceous Sediments

10-70% siliceous microfossils  
30-90% terrigenous components (mud)  
<30%  $\text{CaCO}_3$

If diatoms <mud: diatomaceous mud (stone).

If diatoms >mud: muddy diatom ooze (muddy diatomite).

If  $\text{CaCO}_3$  10-30%: appropriate qualifier is used (see III).

V Pelagic Biogenic Calcareous Sediments

>30%  $\text{CaCO}_3$

<30% terrigenous components  
<30% siliceous microfossils

Principal components are nannofossils and foraminifera; qualifiers are used as follows:

<u>Foram %</u>	<u>Name</u>
<10	nannofossil ooze (chalk, limestone)
10-25	foraminiferal-nannofossil ooze
25-50	nannofossil-foraminiferal ooze
>50	foraminiferal ooze

Calcareous sediment containing 10-30% siliceous fossils carry the qualifier radiolarian, diatomaceous or siliceous depending upon the identification.

#### VI Transitional Biogenic Calcareous Sediments

>30% CaCO<sub>3</sub>  
>30% terrigenous components  
<30% siliceous microfossils

If CaCO<sub>3</sub> 30-60%: marly is used as a qualifier:

soft: marly calcareous (or nannofossil, etc.) ooze.  
firm: marly chalk (or marly nannofossil chalk, etc.).  
hard: marly limestone (or marly nannofossil limestone,

If CaCO<sub>3</sub> >60%:

soft: calcareous (or nannofossil, etc.) ooze.  
firm: chalk (or nannofossil chalk, etc.).  
hard: limestone (or nannofossil limestone, etc.).

NOTE: Sediments containing 10-30% CaCO<sub>3</sub> fall in other classes where they are denoted with the adjective "calcareous", "nannofossil", etc.

#### VII Terrigenous Sediments

>30% terrigenous  
<30% CaCO<sub>3</sub>  
<10% siliceous microfossils  
<10% authigenic components

Sediments in this category are subdivided into textural groups on the basis of the relative proportions of three grain-size components, i.e. sand, silt and clay. Sediments coarser than sand-size are treated as "Special Rock Types". The size limits are those

defined by Wentworth (1922). The textural classification is according to the triangular diagram of Shepard (1954) (Figure ). The suffix "-stone" is used to indicate hard or consolidated equivalents of the unconsolidated sediments.

If  $\text{CaCO}_3$  is 10-30%: calcareous, nannofossil, etc. is used as a qualifier.

Other qualifiers (e.g. feldspathic, glauconitic, etc.) are used for components >10%.

## VIII Volcanogenic Sediments

- a) Pyroclastic rocks are described according to the textural and compositional scheme of Wentworth and Williams (1932). The textural groups are:

Volcanic breccia 32mm  
Volcanic lapilli 32mm  
Volcanic ash (tuff, if indurated) 4mm

Compositionally, these pyroclastic rocks are described as vitric (glass), crystal or lithic.

- b) Clastic sediments of volcanic provenance are described in the same fashion as the terrigenous sediments, noting the dominant composition of the volcanic grains where possible.

## Lithologic Symbols

Figure 4 shows the graphic symbols used to depict the lithologies encountered on Leg 47A.

## Core Forms

The core forms provide a variety of data. Shipboard paleontological determinations are provided in appropriate columns along the left hand margin. In the column headed "Graphic Lithology", appropriate symbols are used to depict lithologies found in the cores. The columns titled "Drilling Disturbance" and "Sedimentary Structures" provide information on these aspects of the cores according to the conventions previously described. Drilling disturbance symbols were shown on page 9. Conventions relating to sedimentary structures are shown on Figure 5. All smear slides made aboard the ship are appropriately located in the column headed "Lithologic Samples".

The broad column headed "Lithologic Description" provides a variety of data. Along the left margin are found the color descriptions according to the Munsell color designations. Boundaries where color changes occur are shown by short horizontal lines. The symbol —

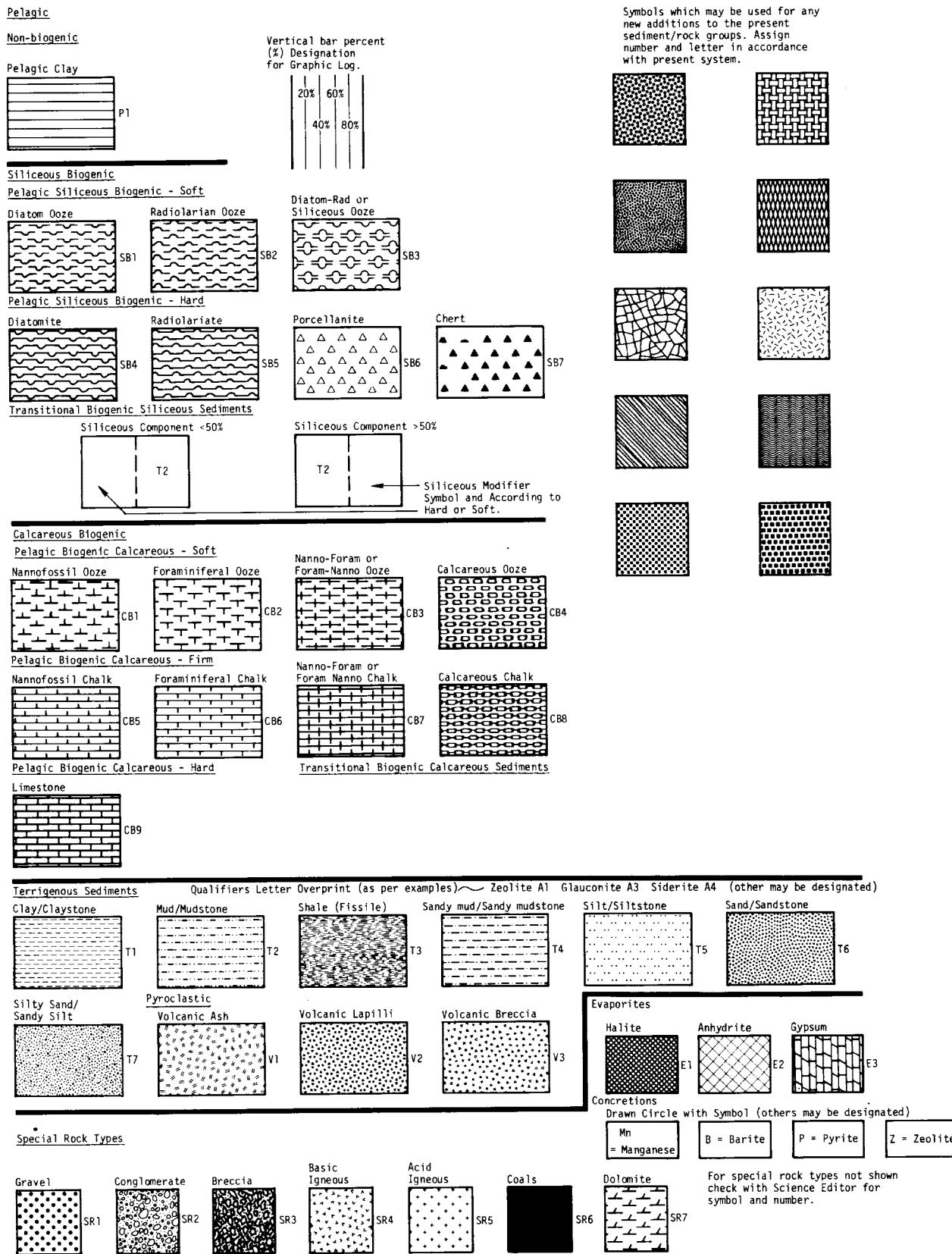


Figure 4. Key to Lithologic and Biostratigraphic Symbols.

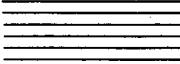
BIOTURBATION	
BURROWS	
GRADED BED	
GRADATIONAL CONTACT (hand drawn)	
SHARP CONTACT (hand drawn)	
PARALLEL LAMINATIONS	
CROSS STRATIFICATION	
MASSIVE OR HOMOGENEOUS (no symbol necessary)	
SEDIMENTARY CLASTS	
SLUMP	

FIGURE 5 SEDIMENTARY STRUCTURE SYMBOLS

The Sedimentary Structure Symbols are used in the make-up of Core Forms. They can be found on Format Sheets 6415, 7071, 7215, 7069 and Artist Aid Transfer Sheet 10030. The remaining are hand drawn.

designates an abrupt color change and - - - indicates a gradual change. All smear slides (abbreviated SS) are identified by a centimeter designation corresponding to that shown in the "Lithologic Sample" column. The percentage occurrence of each constituent is indicated, based on visual estimates. The estimates of the carbonate constituents may vary by small or large amounts from that determined by the carbonate bomb or the LECO. Where a large difference occurred the instrumentally determined values are used to define the amount of carbonate indicated in the "Graphic Lithology" column.

#### Biostratigraphy

At the time of this compilation biostratigraphic studies of Leg 47A material are still in progress. Revisions in nannofossil ages to date have been incorporated. A radiolarian specialist was not on board the *Glomar Challenger* during Leg 47A; consequently, no radiolarian zonal assignments are given.

The Cenozoic planktonic foraminiferal zonation used follows the letter/number scheme of Blow for the Miocene and for the Quaternary. The Pliocene zonation follows the letter/number scheme of Cita (1975) which is preferred because it is based on biostratigraphic horizons calibrated to the paleomagnetic stratigraphy.

The nannofossil zonation follows the letter/number scheme of Martini (1971) for the Neogene and of Thierstein (1971) for the Cretaceous.

## SAMPLE DISTRIBUTION POLICY

### Deep Sea Drilling Project/International Phase of Ocean Drilling

Distribution of Deep Sea Drilling samples for investigation will be undertaken in order to (1) provide supplementary data to support GLOMAR CHALLENGER scientists in achieving the scientific objectives of their particular cruise, and in addition to serve as a mechanism for contributions to the INITIAL REPORTS; (2) provide individual investigators with materials to conduct detailed studies beyond the scope of the Initial Reports; and (3) provide the reference centers where paleontologic materials are stored with samples for reference and comparison purposes.

The National Science Foundation has established a Sample Distribution Panel to advise on the distribution of core materials. This panel is chosen in accordance with usual Foundation practices, in a manner that will assure advice in the various disciplines leading to a complete and adequate study of the cores and their contents. Funding for the proposed research must be secured separately by the investigator. It cannot be provided through the Deep Sea Drilling Project.

The Deep Sea Drilling Project's Curator is responsible for distributing the samples and controlling their quality, as well as preserving and conserving core material. He also is responsible for maintaining a record of all samples that have been distributed, shipboard and subsequent, indicating the recipient, and the natures of the proposed investigation. This information is made available to all investigators of DSDP materials as well as other interested researchers on request.

The distribution of samples is made directly from one of the two existing repositories, Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography, by the Curator or his designated representative.

#### 1. Distribution of Samples for Research Leading to Contributions to Initial Reports

Any investigator who wishes to contribute a paper to a given volume of the Initial Reports may write to the Chief Scientist, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A., requesting samples from a forthcoming cruise. Requests for a specific cruise should be received by the Chief Scientist TWO MONTHS in advance of the departure of the cruise in order to allow time for the review and consideration of all requests and to establish a suitable shipboard sampling program. The request should include a statement of the nature of the study proposed, size and approximate number of samples required to complete the study, and any particular sampling technique or equipment that might be required. The requests will be reviewed by the Chief Scientist of the Project and the cruise co-chief scientists; approval will be given in accordance with the scientific requirements of the cruise as determined by the appropriate JOIDES Advisory Panel(s). If approved, the requested samples will be taken, either by the shipboard party if the workload permits, or by the curatorial staff shortly following the return of the cores to the repository. Proposals must be of a scope to ensure that samples can be processed and a contribution completed in time for publication in the Initial Reports. Except for rare, specific instances involving ephemeral properties, sampling will not exceed one-quarter of the volume of core recovered, with no interval being depleted and one-half of all core being retained as an archive. Shipboard sampling shall not exceed approximately 100 igneous samples per investigator; in all cases co-chief scientists are requested to keep sampling to a minimum.

The co-chief scientists may elect to have special studies of selected core samples made by other investigators. In this event the names of these investigators and complete listings of all materials loaned or distributed must be forwarded, if possible, prior to the cruise or, as soon as possible following the cruise, to the Chief Scientist

through the DSDP Staff Science Representative for that particular cruise. In such cases, all requirements of the Sample Distribution Policy shall also apply.

If a dispute arises or if a decision cannot be reached in the manner prescribed, the NSF Sample Distribution Panel will conduct the final arbitration.

Any publication of results other than in the Initial Reports within twelve (12) months of the completion of the cruise must be approved and authored by the whole shipboard party and, where appropriate, shore-based investigators. After twelve months, individual investigators may submit related papers for open publication provided they have submitted their contributions to the Initial Reports. Investigations not completed in time for inclusion in the Initial Reports for a specific cruise may not be published in other journals until final publication of that Initial Report for which it was intended. Notice of submission to other journals and a copy of the article should be sent to the DSDP Chief Science Editor.

#### 2. Distribution of Samples for Research Leading to Publication other than in Initial Reports

A. Researchers intending to request samples for studies beyond the scope of the Initial Reports should first obtain sample request forms from the Curator, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A. On the forms the researcher is requested to specify the quantities and intervals of the core required, make a clear statement of the proposed research, state time required to complete and submit results for publication, specify the status of funding and the availability of equipment and space foreseen for the research.

In order to ensure that all requests for highly desirable but limited samples can be considered, approval of requests and distribution of samples will not be made prior to 2 months after publication of the Initial Core Descriptions (I.C.D.). ICD's required to be published within 10 months following each cruise. The only exceptions to this policy will be for specific instances involving ephemeral properties. Requests for samples can be based on the Initial Core Descriptions, copies of which are on file at various institutions throughout the world. Copies of original core logs and data are kept on file at DSDP and at the Repository at Lamont-Doherty Geological Observatory, Palisades, New York. Requests for samples from researchers in industrial laboratories will be handled in the same manner as these from academic organizations, with the same obligation to publish results promptly.

B. (1) The DSDP Curator is authorized to distribute samples up to 50 ml per meter of core. Requests for volumes of material in excess of this amount will be referred to the NSF Sample Distribution Panel for review and approval. Experience has shown that most investigations can be accomplished with 10ml sized samples or less. All investigators are encouraged to be as judicious as possible with regard to sample size and, especially, frequency within any given core interval. The Curator will not automatically distribute any parts of the cores which appear to be in particularly high demand; requests for such parts will be referred to the Sample Distribution Panel for review. Requests for samples from thin layers or important stratigraphic boundaries will also require Panel review.

(2) If investigators wish to study certain properties which may deteriorate prior to the normal availability of his samples, they may request that the normal waiting period not apply. All such requests must be reviewed by the curators and approved by the NSF Sample Distribution Panel.

C. Samples will not be provided prior to assurance that funding for sample studies either exists or is not needed. However, neither formal approval of sample

requests nor distribution of samples will be made until the appropriate time (Item A). If a sample request is dependent, either wholly or in part, on proposed funding, the organization to whom the funding proposal has been submitted any information on the availability (or potential availability) of samples that it may request.

D. Investigators receiving samples are responsible for:

(1) publishing significant results; however contributions shall not be submitted for publication prior to 12 months following the termination of the appropriate leg;

(2) acknowledging, in publications, that samples were supplied through the assistance of the U.S. National Science Foundation and others as appropriate;

(3) submitting five (5) copies (for distribution to the Curator's file, the DSDP Repositories, the GLOMAR CHALLENGER's Library, and the National Science Foundation) of all reprints of published results to the Curator, Deep Sea Drilling Project (A-012), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A.;

(4) returning, in good condition, the remainders of samples after termination of research, if requested by the Curator.

E. Cores are made available at repositories for investigators to examine and to specify exact samples in such instances as may be necessary for the scientific purposes of the sampling, subject to the limitations of B (1 and 2) and D, above, with specific permission of the Curator or his delegate.

F. Shipboard-produced smear slides of sediments and thin sections of indurated sediments, igneous and metamorphic rocks, will be returned to the appropriate repository at the end of each cruise or at the publication of the Initial Reports for that cruise. These smear slides and thin sections will form a reference collection of the cores stored at each repository and may be viewed at the respective repositories as an aid in the selection of core samples.

G. The Deep Sea Drilling Project routinely processes by computer most of the quantitative data presented in the Initial Reports. Space limitations in the Initial Reports preclude the detailed presentation of all such data. However, copies of the computer readout are available for those who wish the data for further analysis or as an aid in selecting samples. A charge will be made to recover expenses in excess of \$50.00 incurred in filling requests.

#### 3. Other Records

Magnetics, seismic reflection, down-hole logging, and bathymetric data collected by the GLOMAR CHALLENGER will also be available for distribution at the same time samples become available.

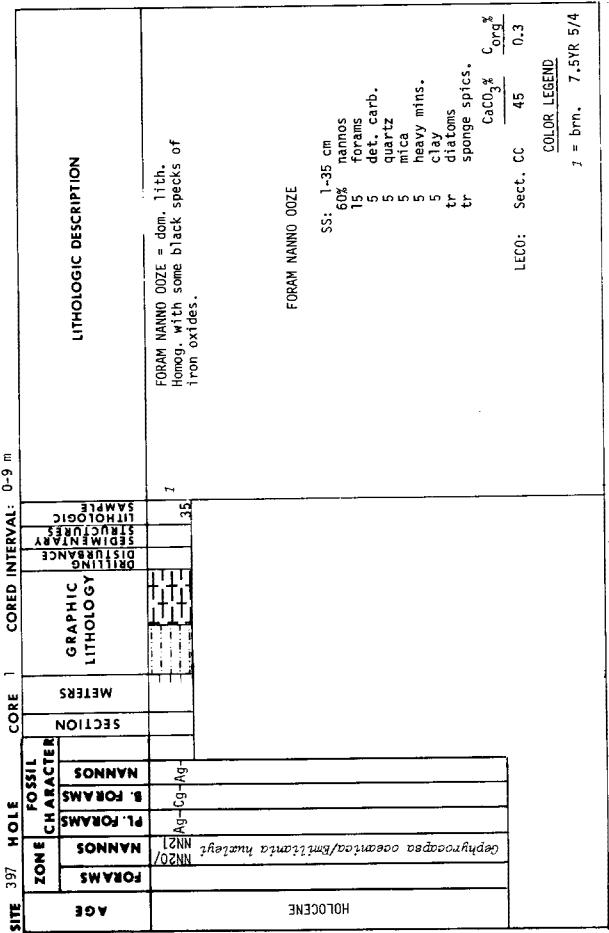
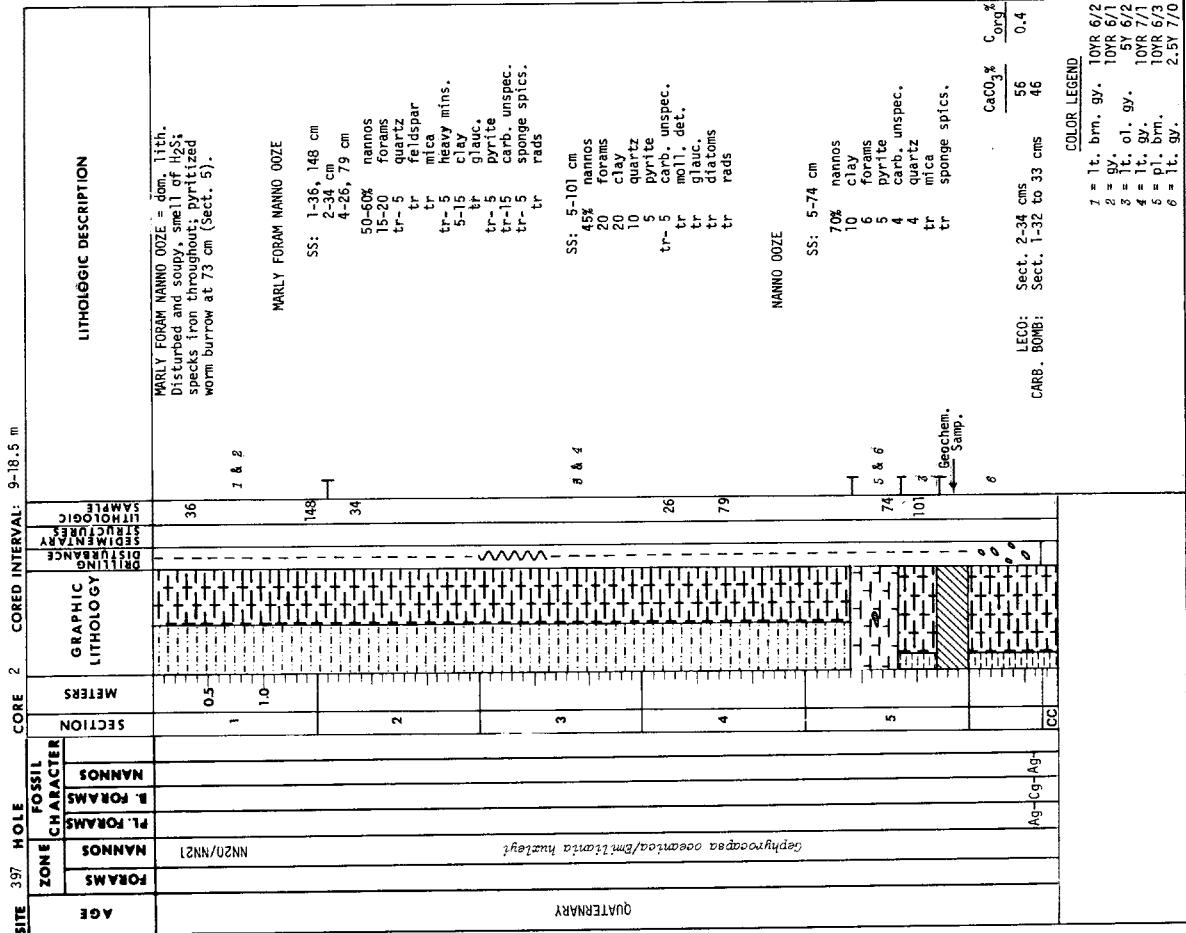
Requests for data may be made to:

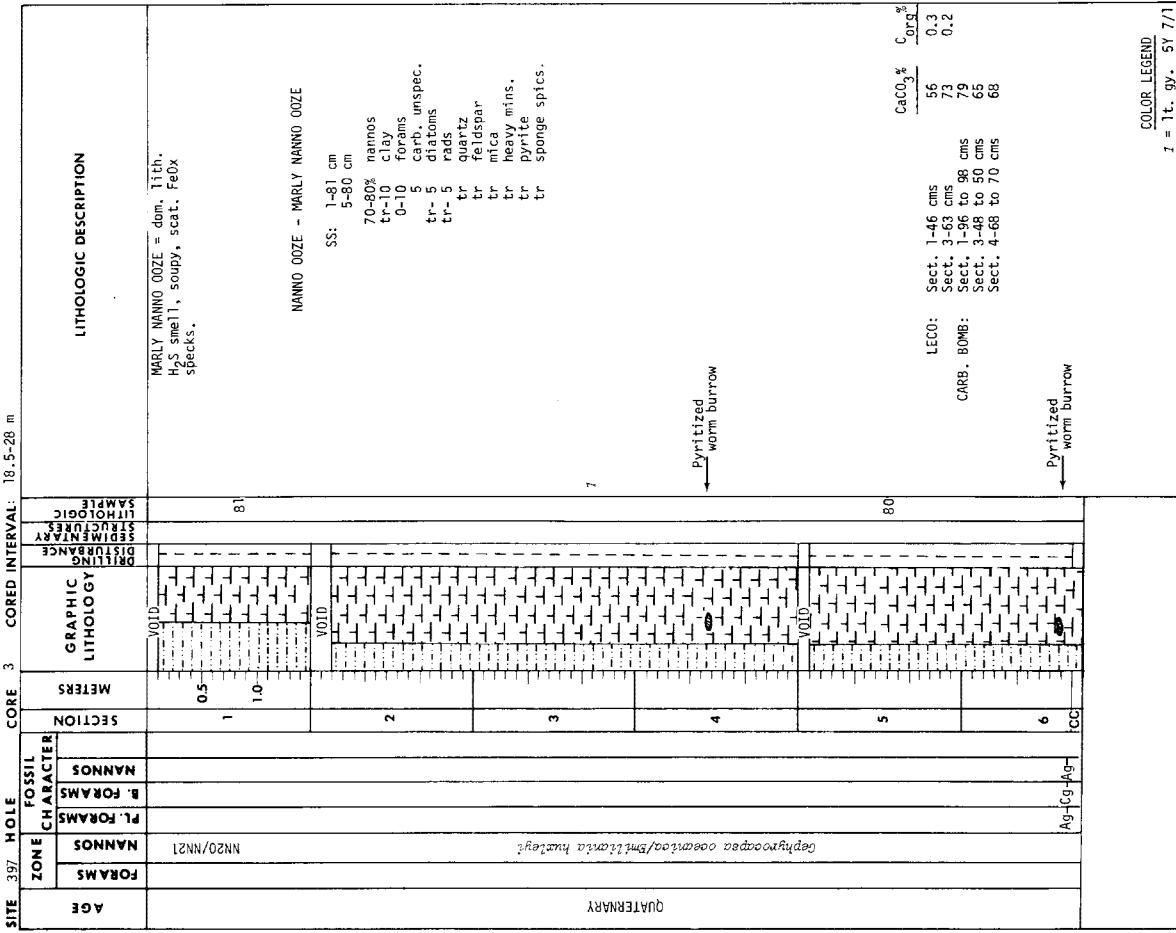
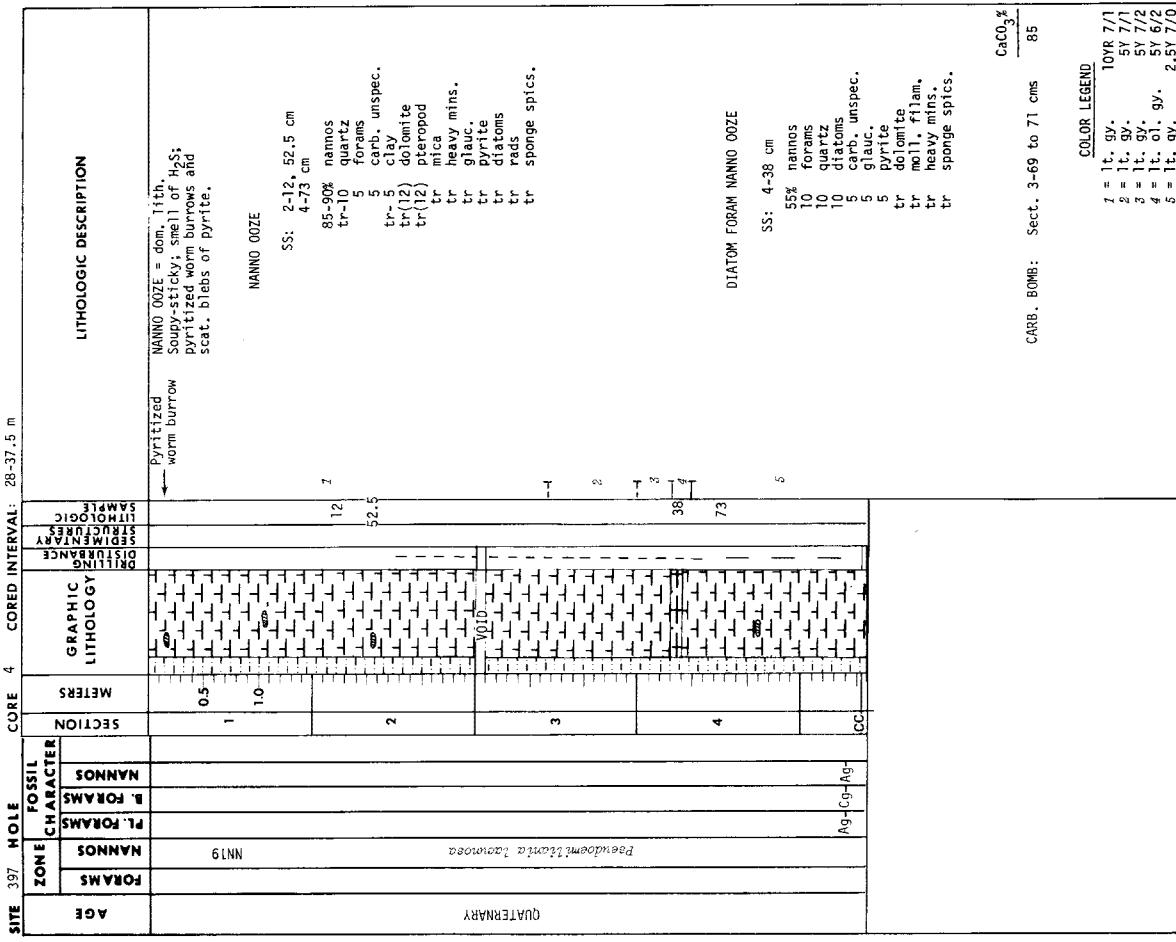
Associate Chief Scientist,  
Science Services  
Deep Sea Drilling Project (A-031)  
Scripps Institution of  
Oceanography  
University of California  
at San Diego  
La Jolla, California 92093

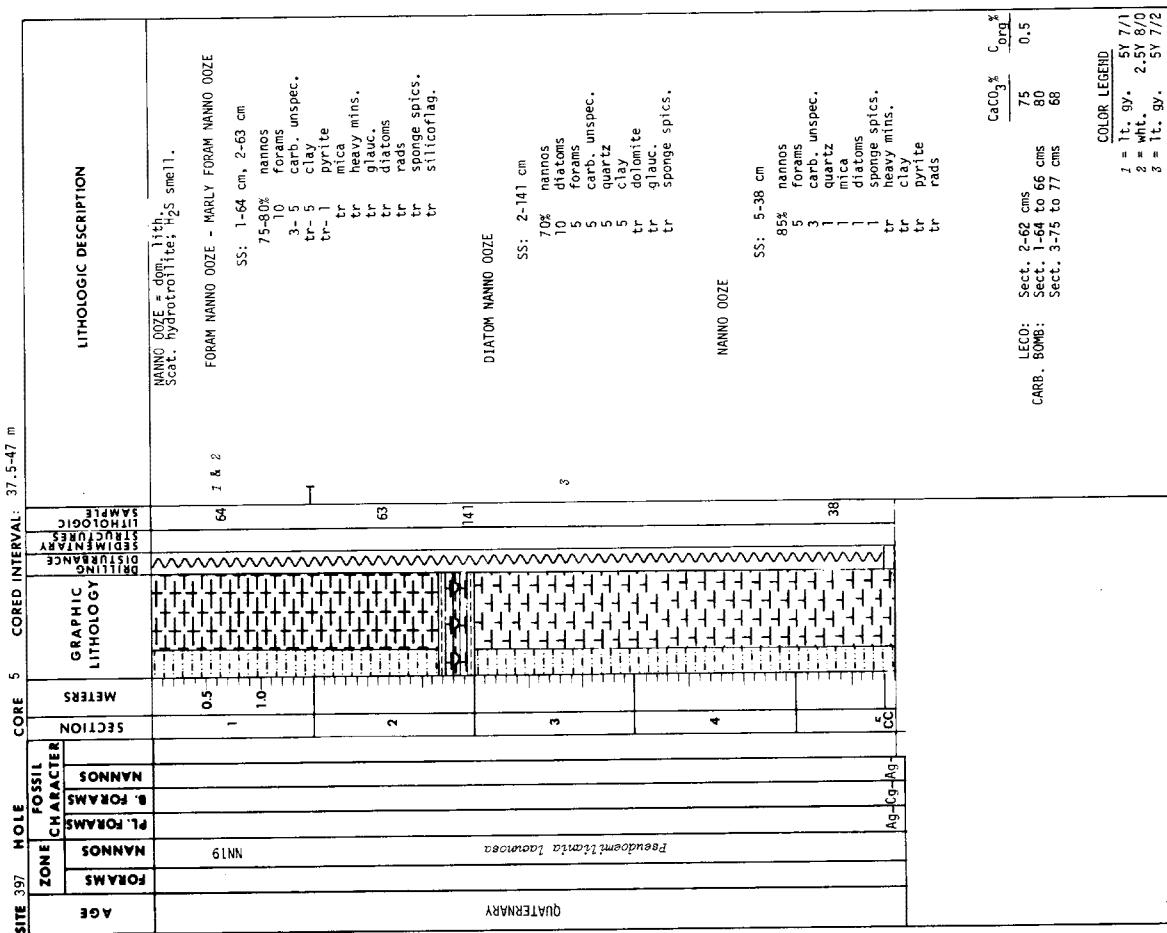
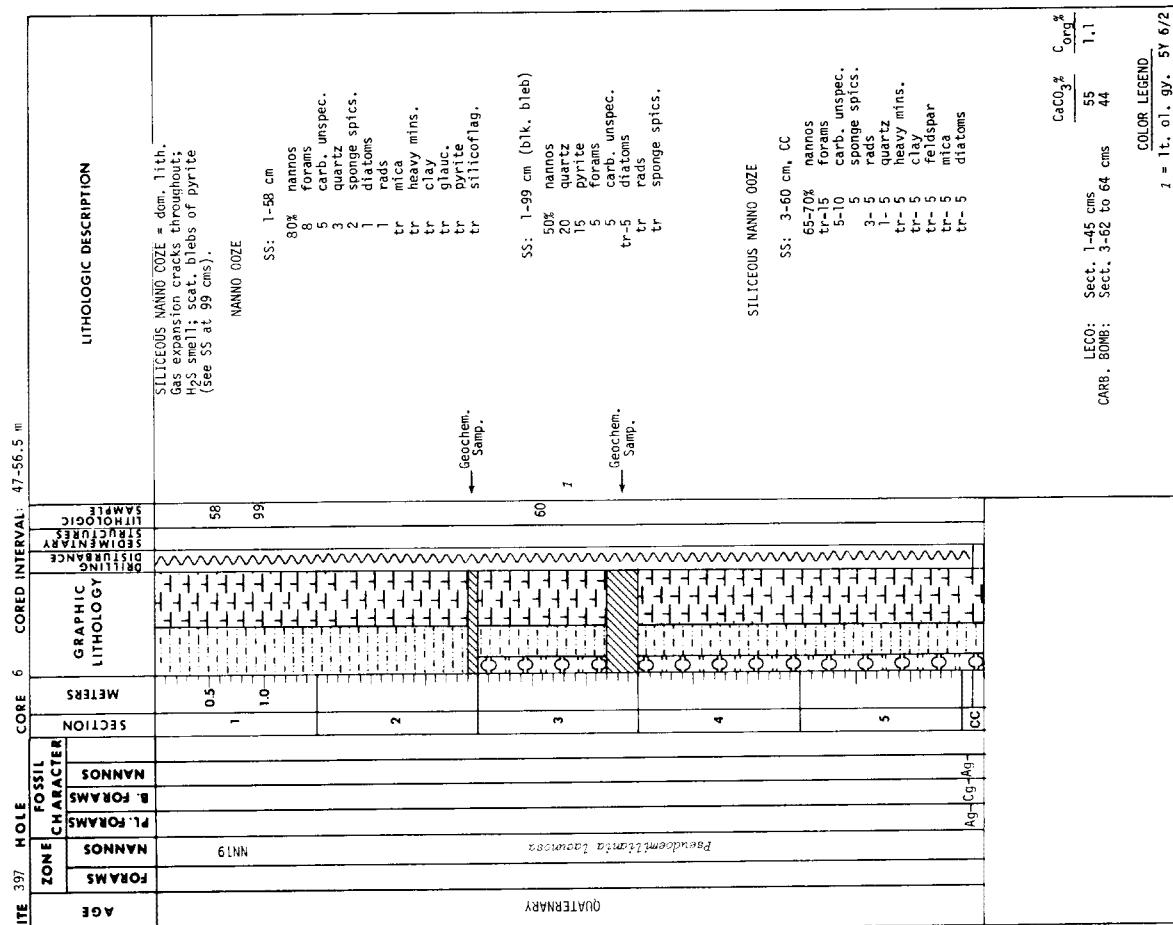
A charge will be made to recover the expenses in excess of \$50.00 in filling individual requests. If required, estimated charges can be furnished before the request is processed.

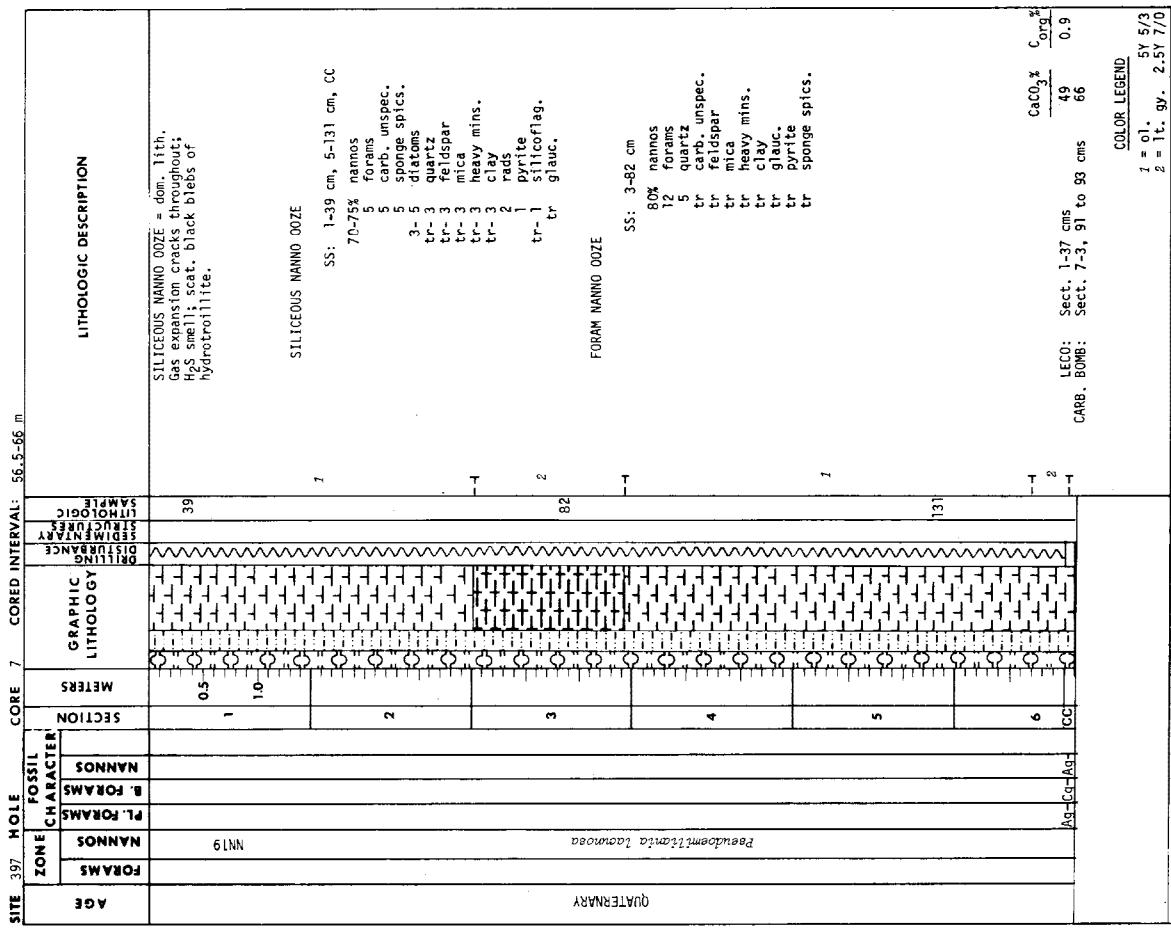
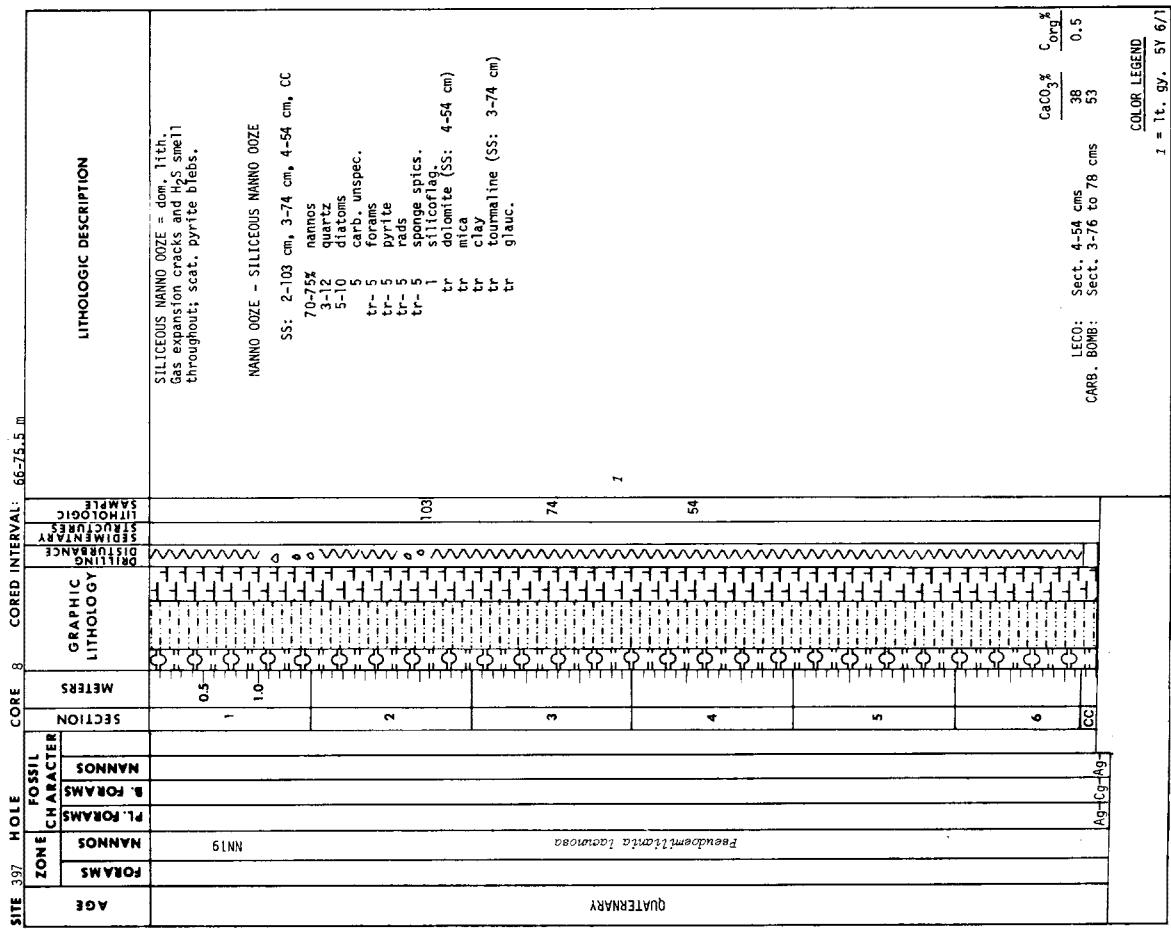
#### 4. Reference Centers

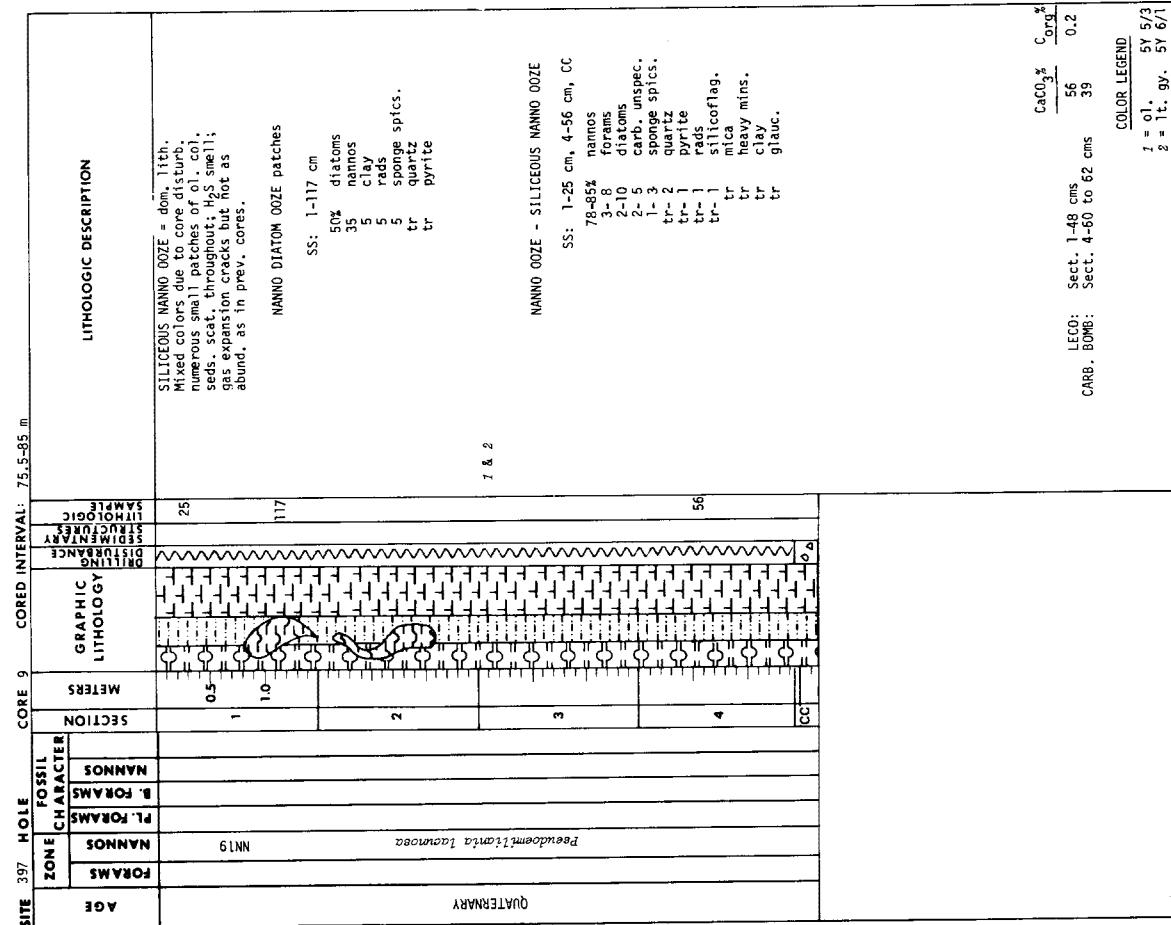
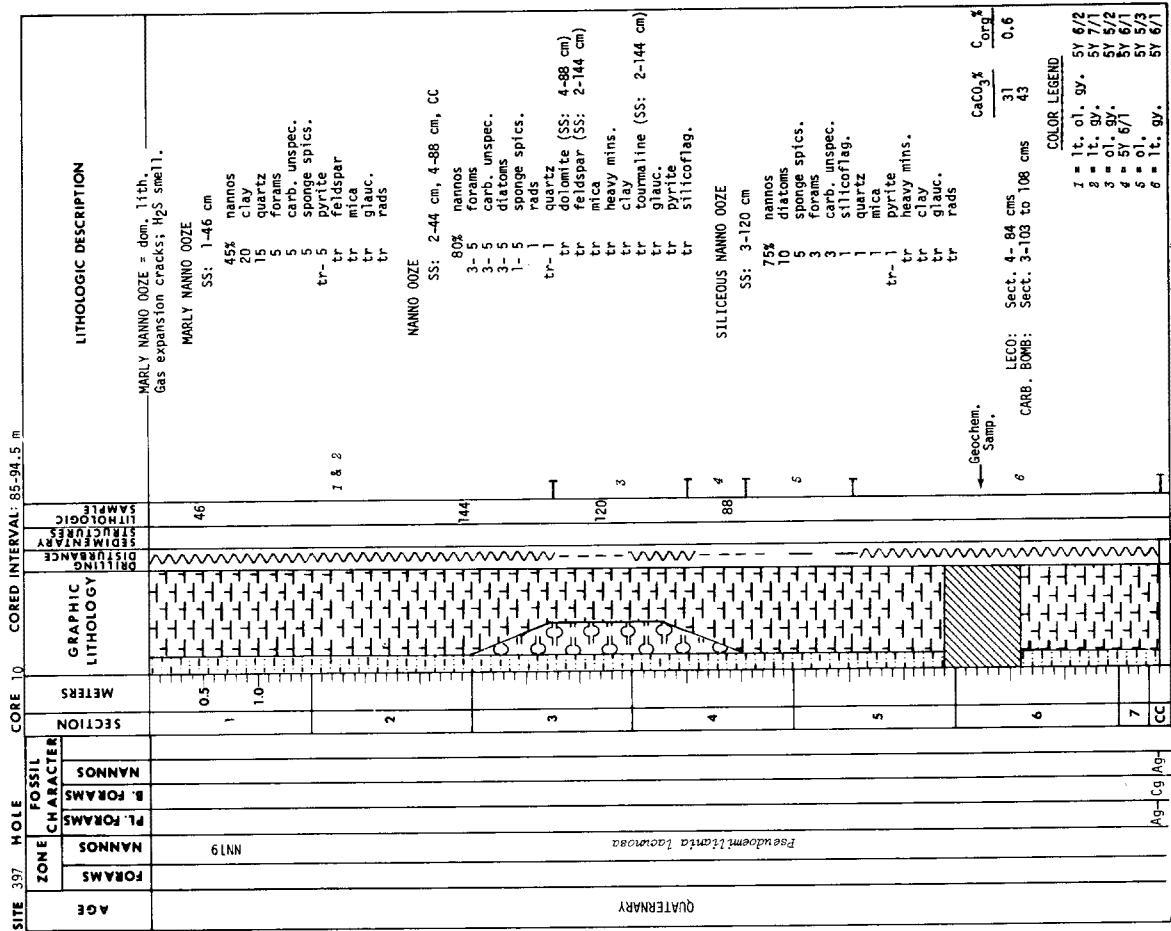
As a separate and special category samples will be distributed for the purpose of establishing up to five reference centers where paleontologic materials will be available for reference and comparison purposes. The first of these reference centers has been approved at Basel, Switzerland.  
Revised 9/28/76



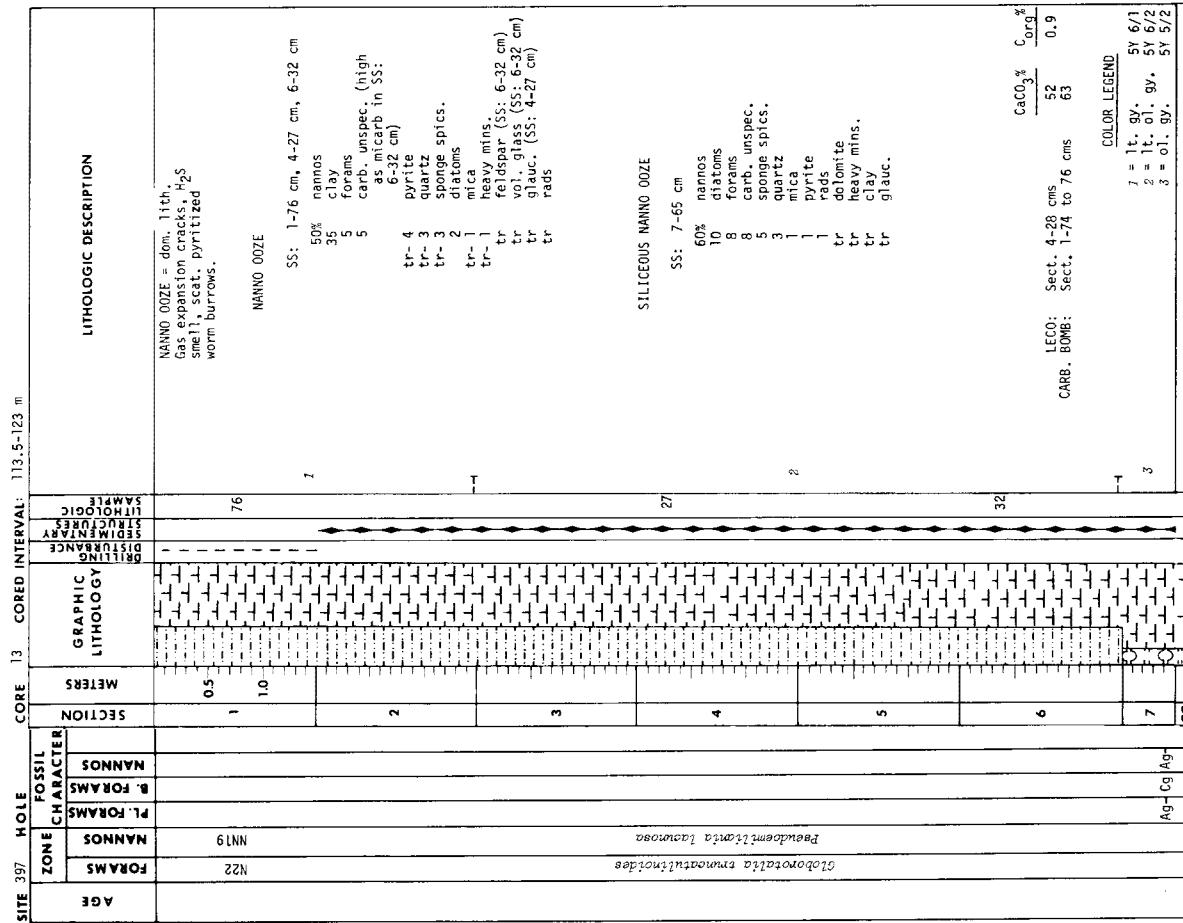
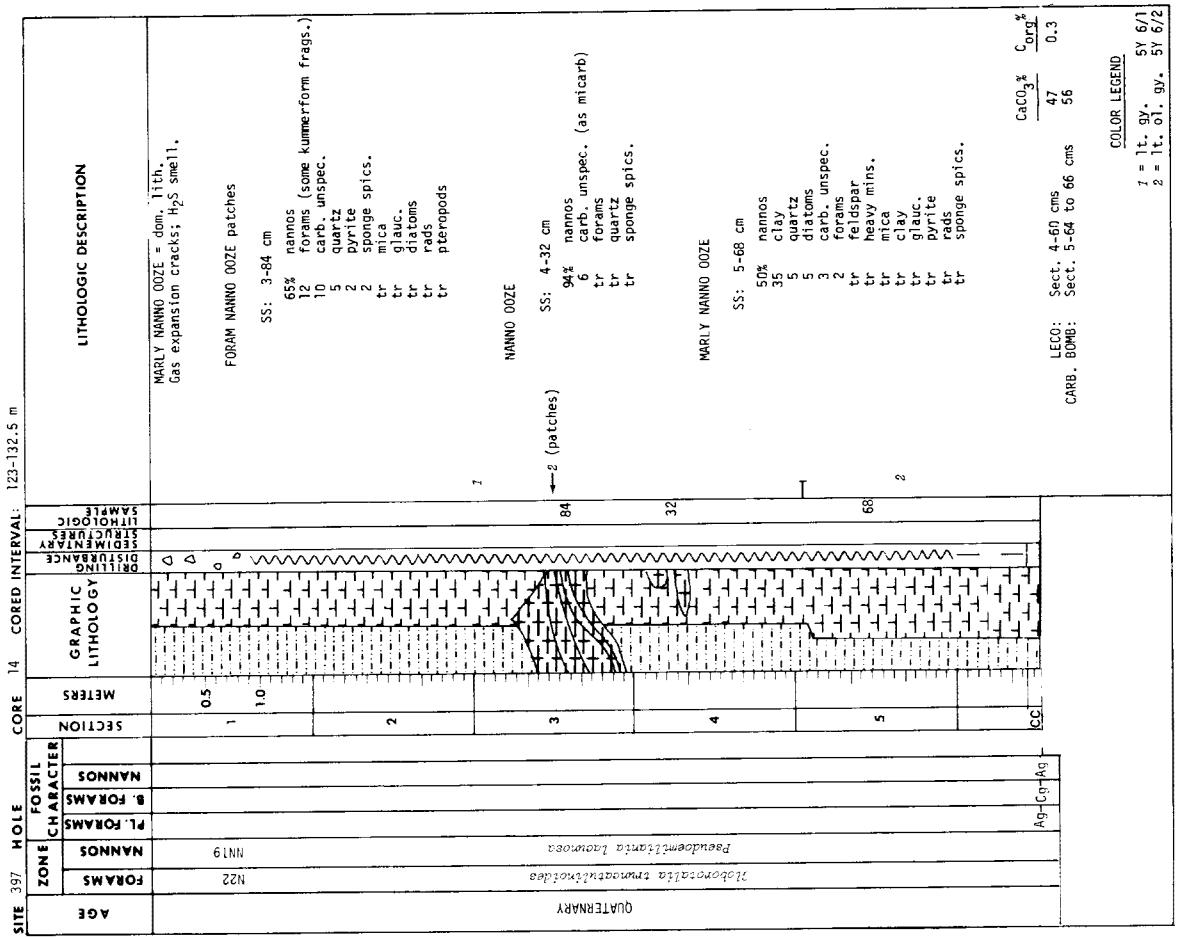


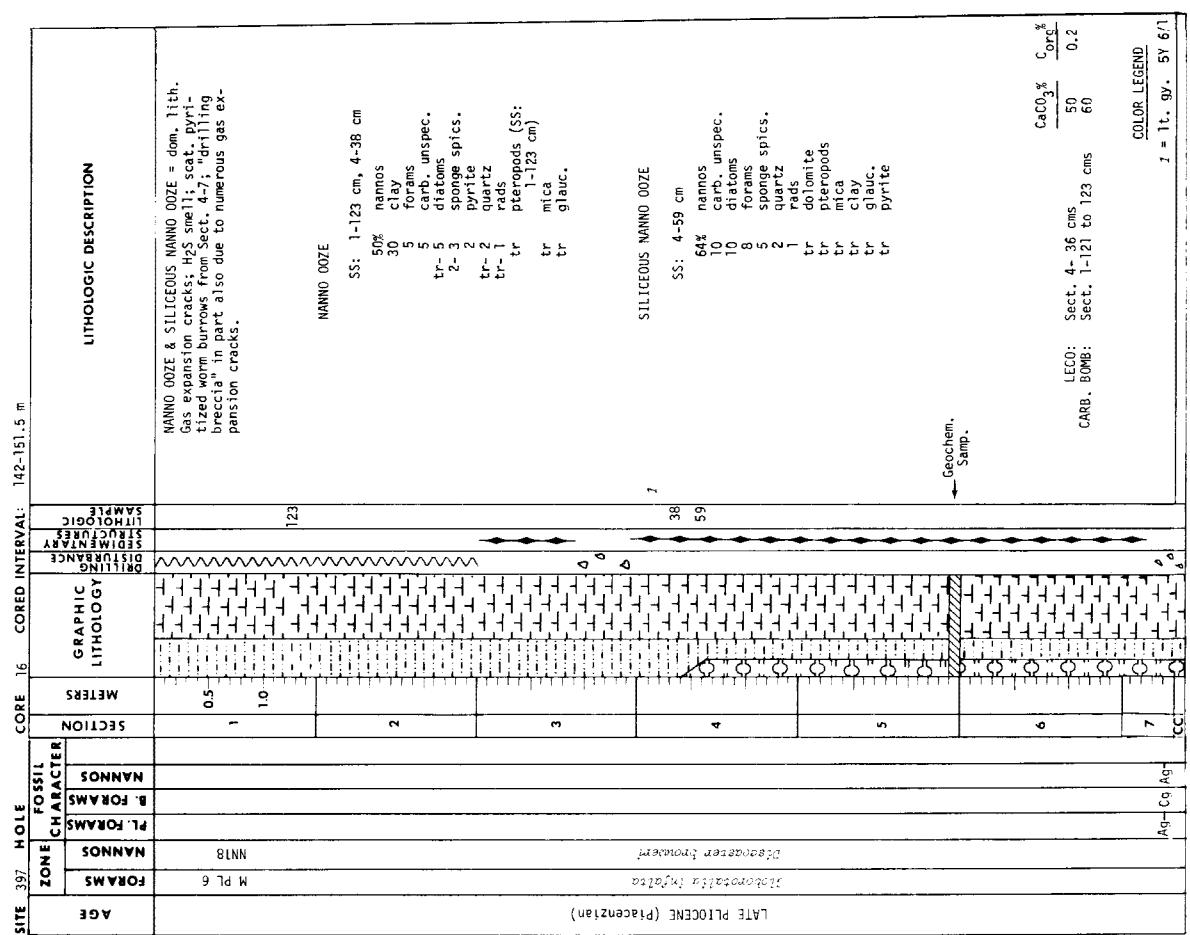




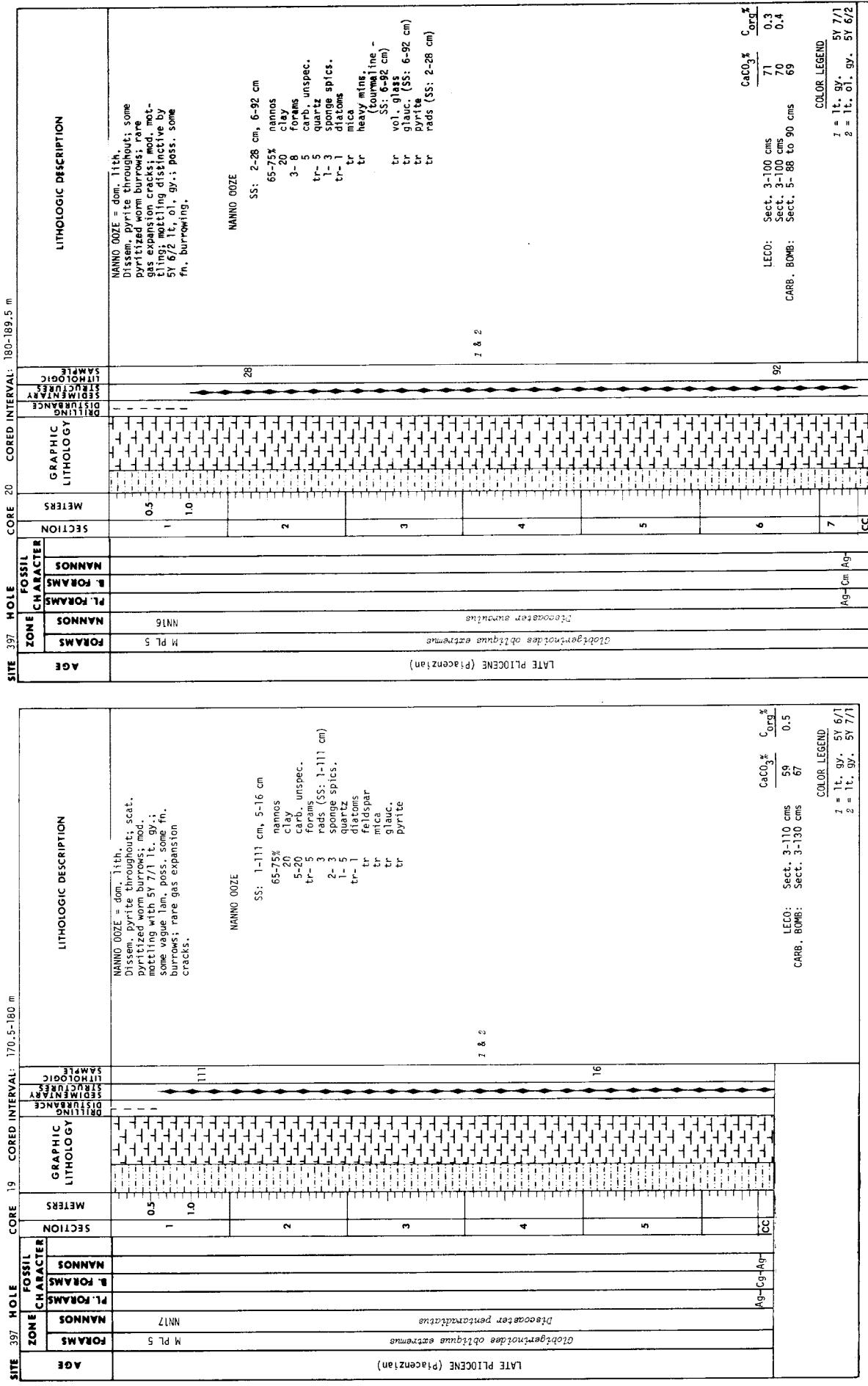


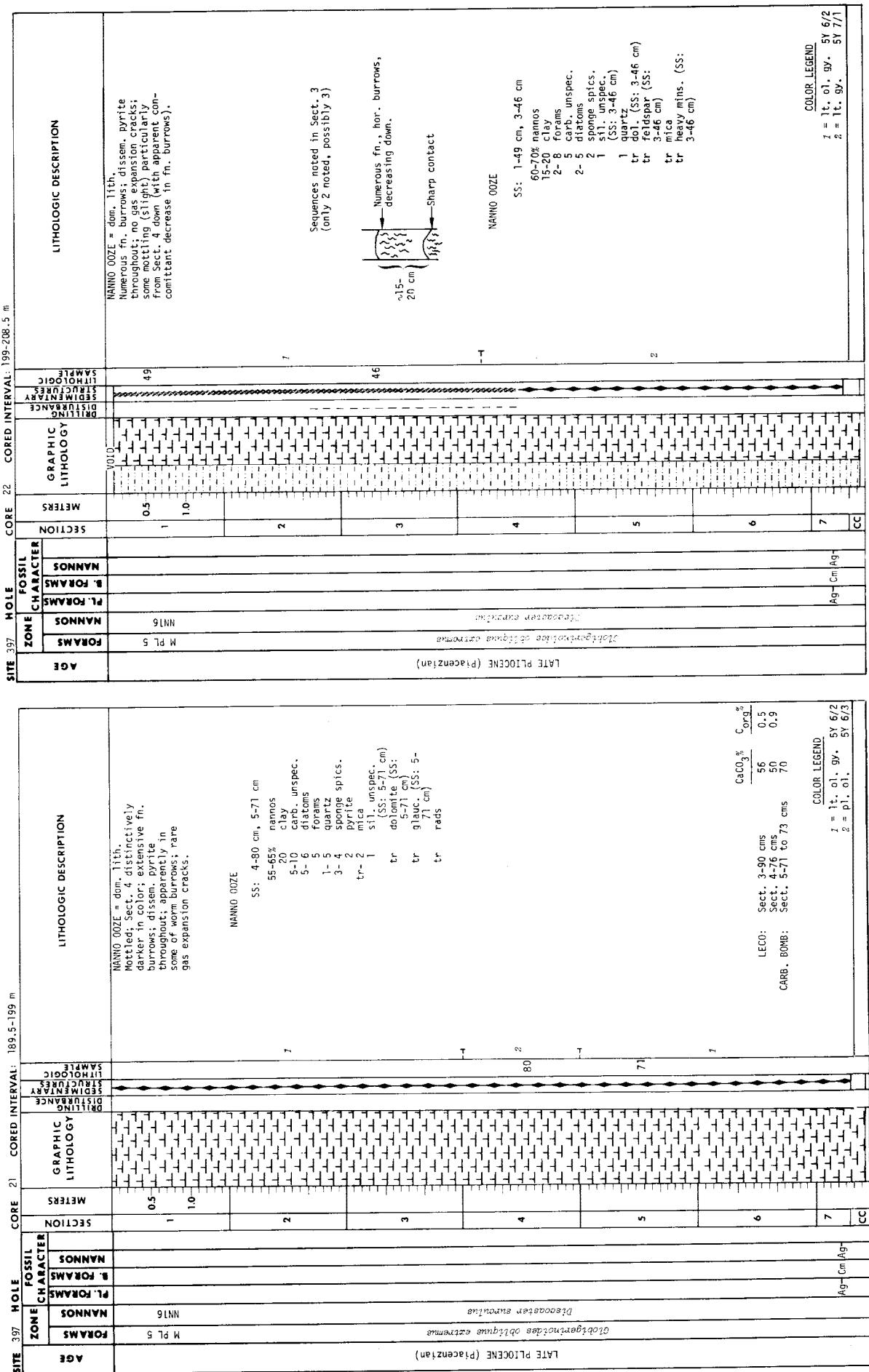


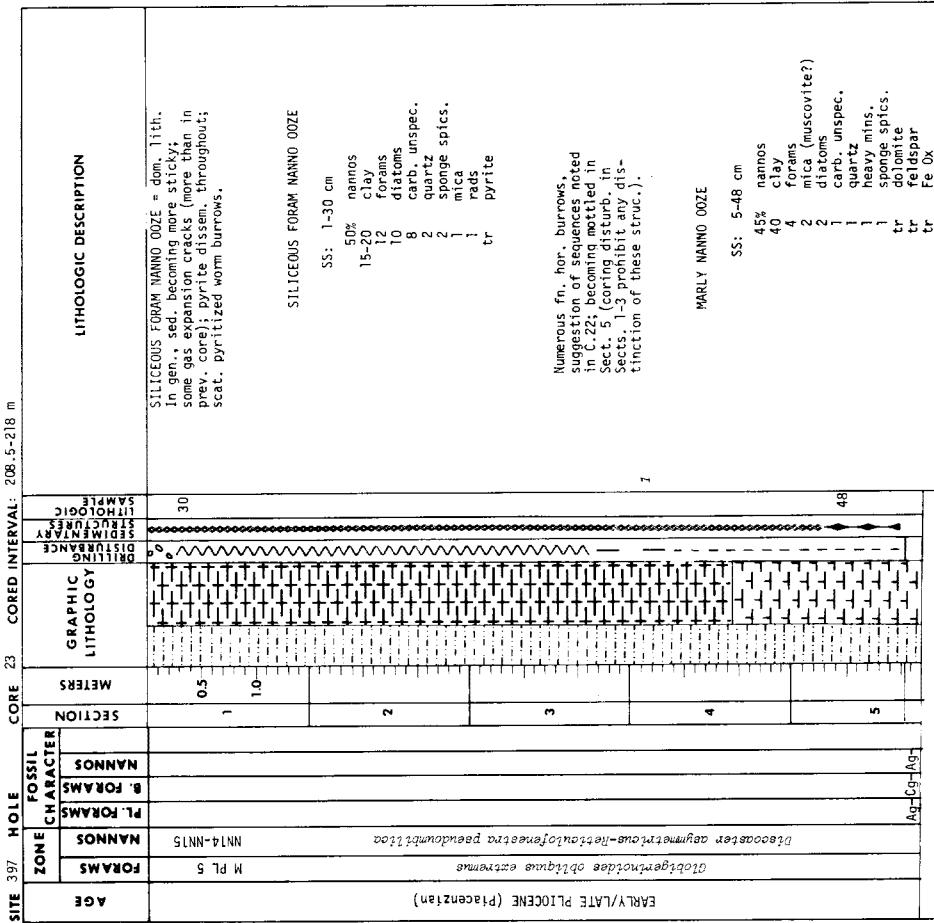
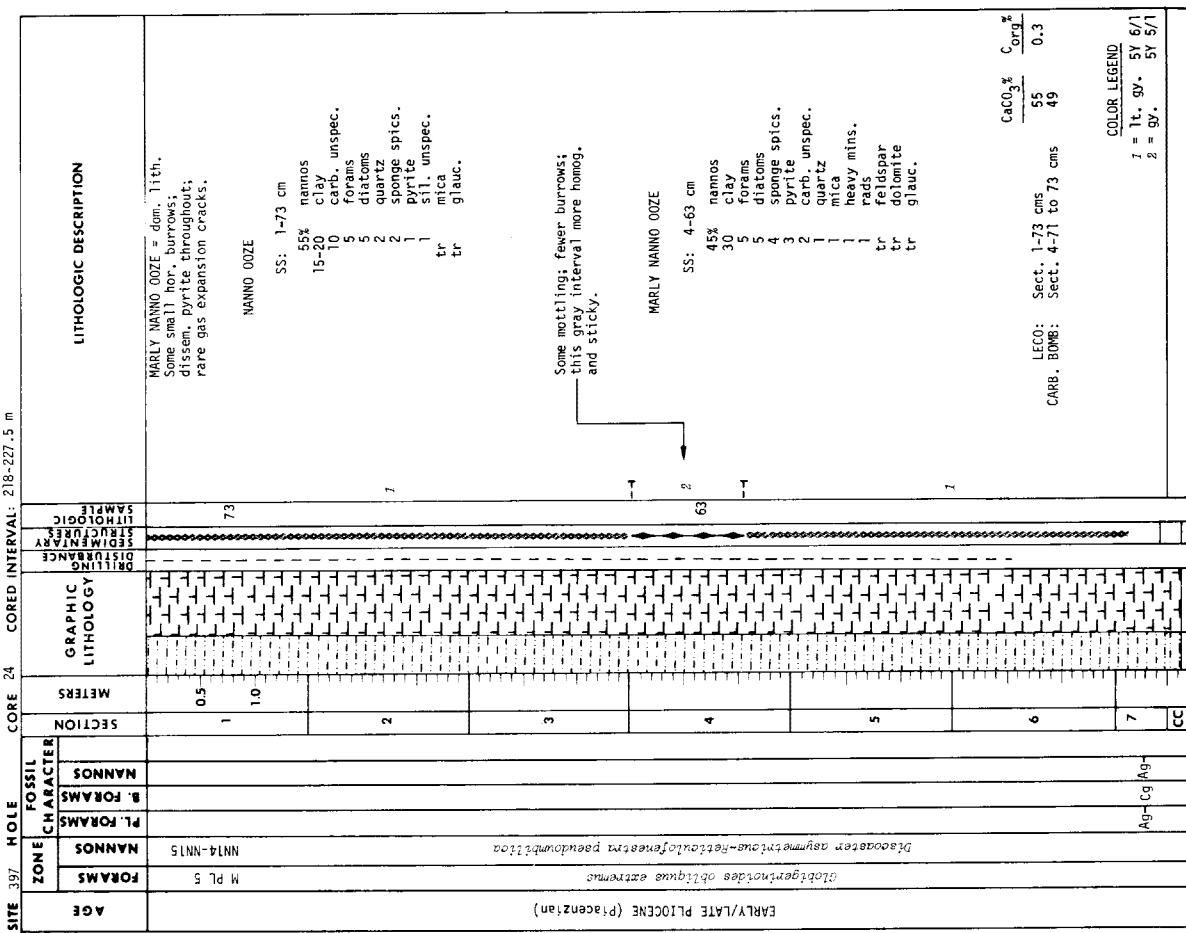








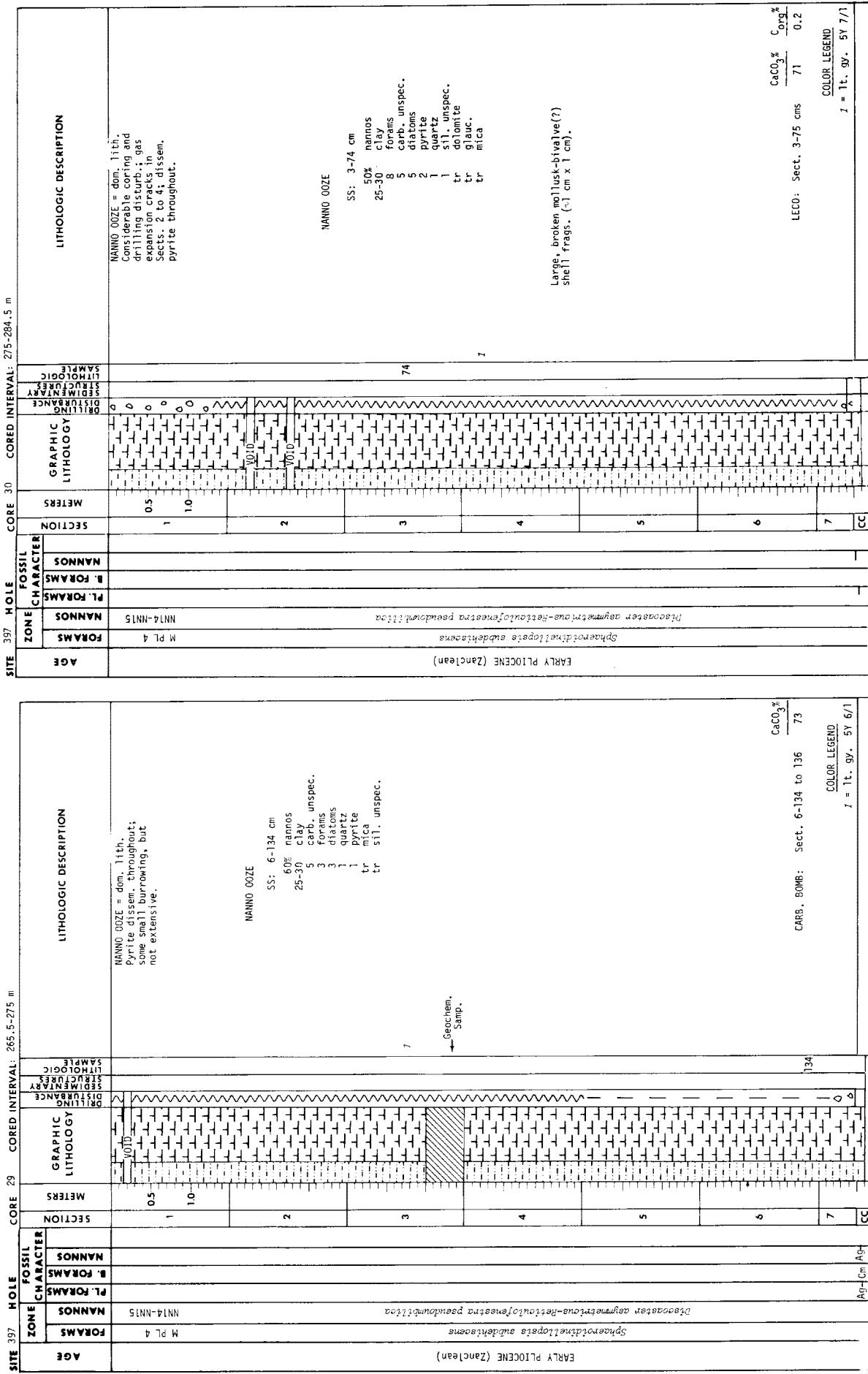


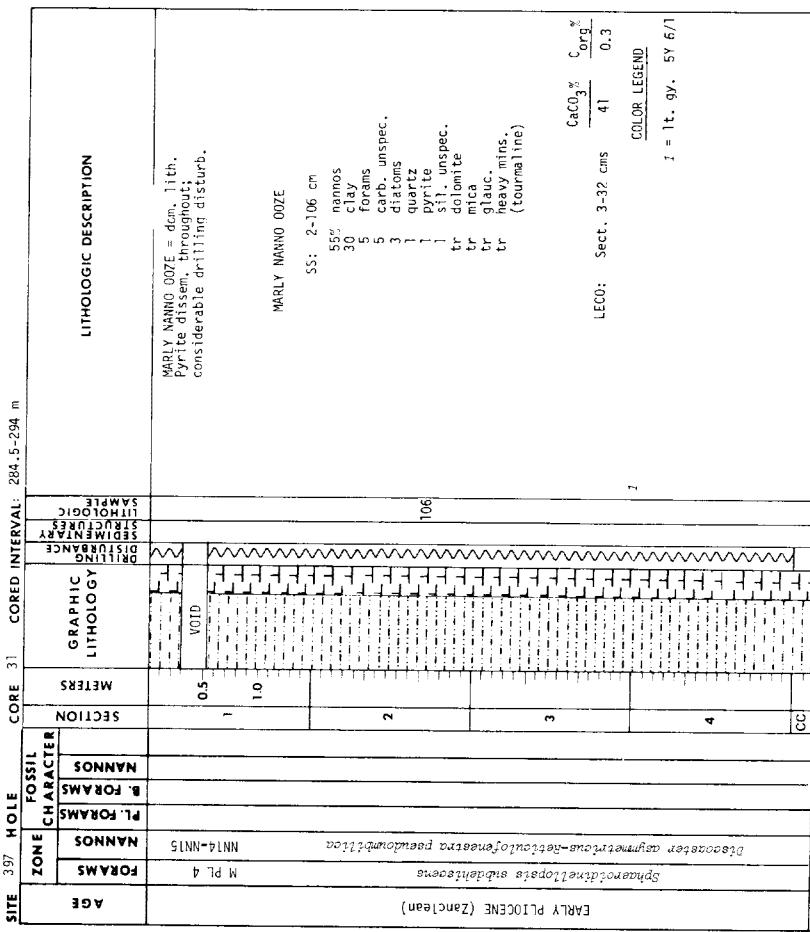
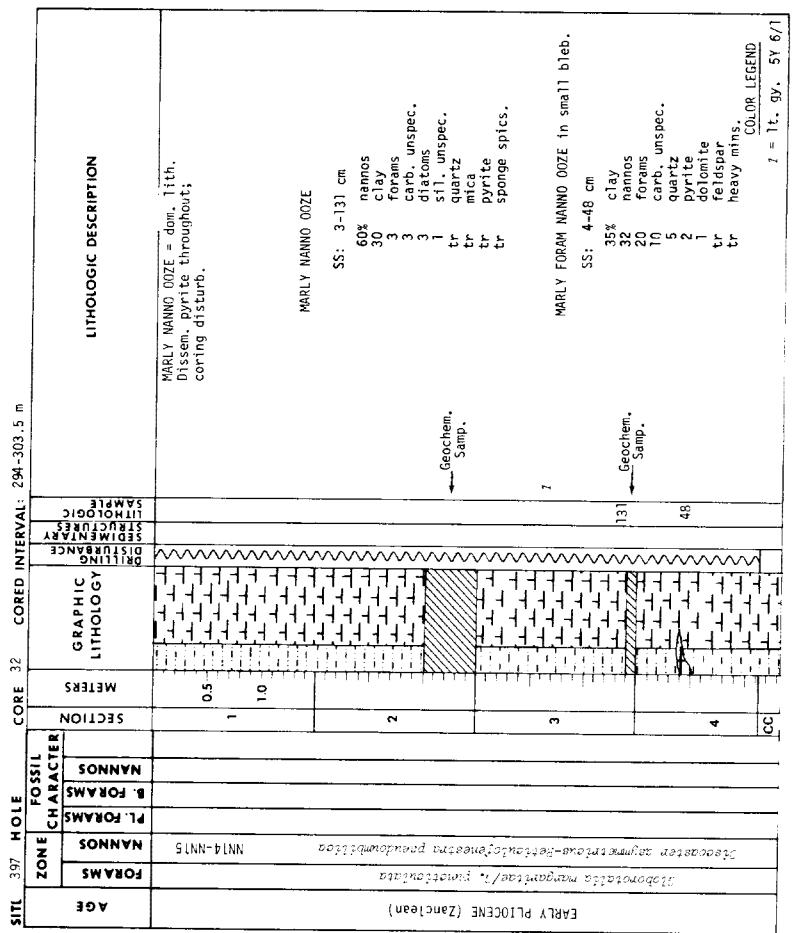


SITE 397 HOLE		CORE 26 CORED INTERVAL: 237-246.5 m	
AGE	FOSIL CHARACTER	METERS	LITHOLOGY
ZONE	CHARACTER	SECTION	GRAPHIC
PL FORMAMS	NANNOS	1	1.0
ML 4	PL FORMAMS	2	0.5
NNI4-NNI5	PL FORMAMS	3	0.5
Discoaster asymmetrica-Pectinolofenestra pseudomultitubica	SPHAEROTILLOPSIS subdebetacens	4	1.0
NNI4-NNI5	ML 4	5	1.0
EARLY/LATE PLIOCENE (Zanclean)	AGE	6	1.0
NANNO Ooze			
SS: 1-4 cm, 3-98 cm, CC			
50-50% nannos			
20-25 clay			
10 carb. unspc.			
5-8 forams			
5-8 diatoms			
1-3 pyrite			
1-3 quartz			
1 mica			
1 sponge spics,			
1 silicic.			
1 dolomite (SS: 2-4 cm,			
7-56 cm)			
tr vol. glass (SS: 2-			
4 cm)			
tr glauc.			
tr rads (SS: 3-98 cm)			
NANNO Ooze			
SS: 1-4 cm, 3-98 cm, CC			
50-50% nannos			
20-25 clay			
10 carb. unspc.			
5-8 forams			
5-8 diatoms			
1-3 pyrite			
1-3 quartz			
1 mica			
1 sponge spics,			
1 silicic.			
1 dolomite (SS: 2-4 cm,			
7-56 cm)			
tr vol. glass (SS: 2-			
4 cm)			
tr glauc.			
tr rads (SS: 3-98 cm)			

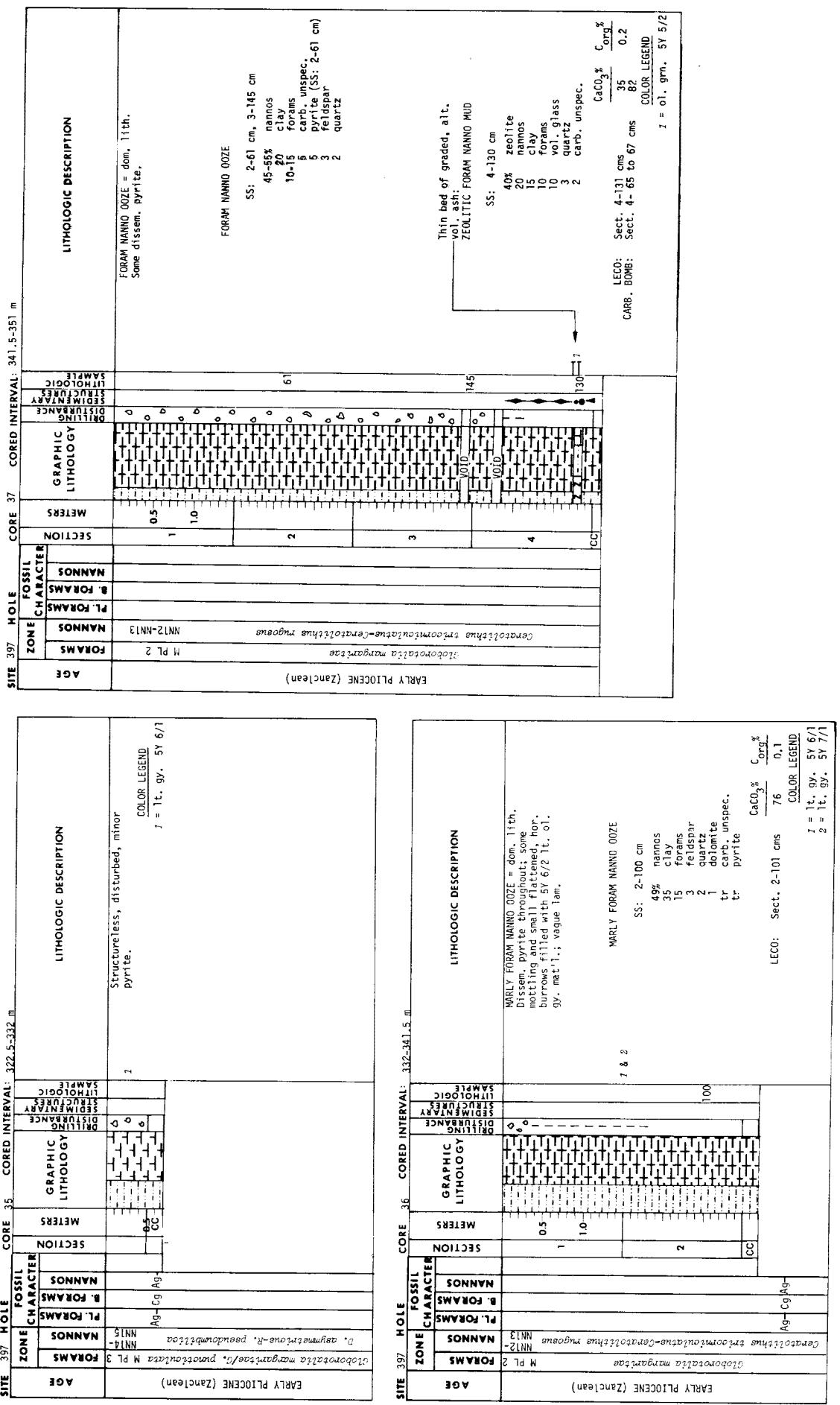
SITE 397 HOLE		CORE 25 CORED INTERVAL: 227.5-237 m	
AGE	FOSIL CHARACTER	METERS	LITHOLOGY
ZONE	CHARACTER	SECTION	GRAPHIC
PL FORMAMS	NANNOS	1	1.0
ML 4	PL FORMAMS	2	0.5
NNI4-NNI5	PL FORMAMS	3	0.5
Discoaster asymmetrica-Pectinolofenestra pseudomultitubica	SPHAEROTILLOPSIS subdebetacens	4	1.0
NNI4-NNI5	ML 4	5	1.0
EARLY/LATE PLIOCENE (Zanclean)	AGE	6	1.0
NANNO Ooze			
SS: 5-62 cm			
45% nannos			
25 clay			
5 carb. unspc.			
(bryozoan frag.)			
4 diatoms			
3 feldspar (altered)			
3 vol. glass			
2 dolomite			
2 mica			
2 heavy min.			
(tourmaline)			
1 pyrite			
1 sponge spics.			
tr glauc.(?)			
CaCO <sub>3</sub> %			
CARB. BOMB: Sect. 5-61 to 53 cms			
72			
COLOR LEGEND			
1 = lt. gy. 5Y 6/1			
2 = lt. gy. 5Y 7/1			

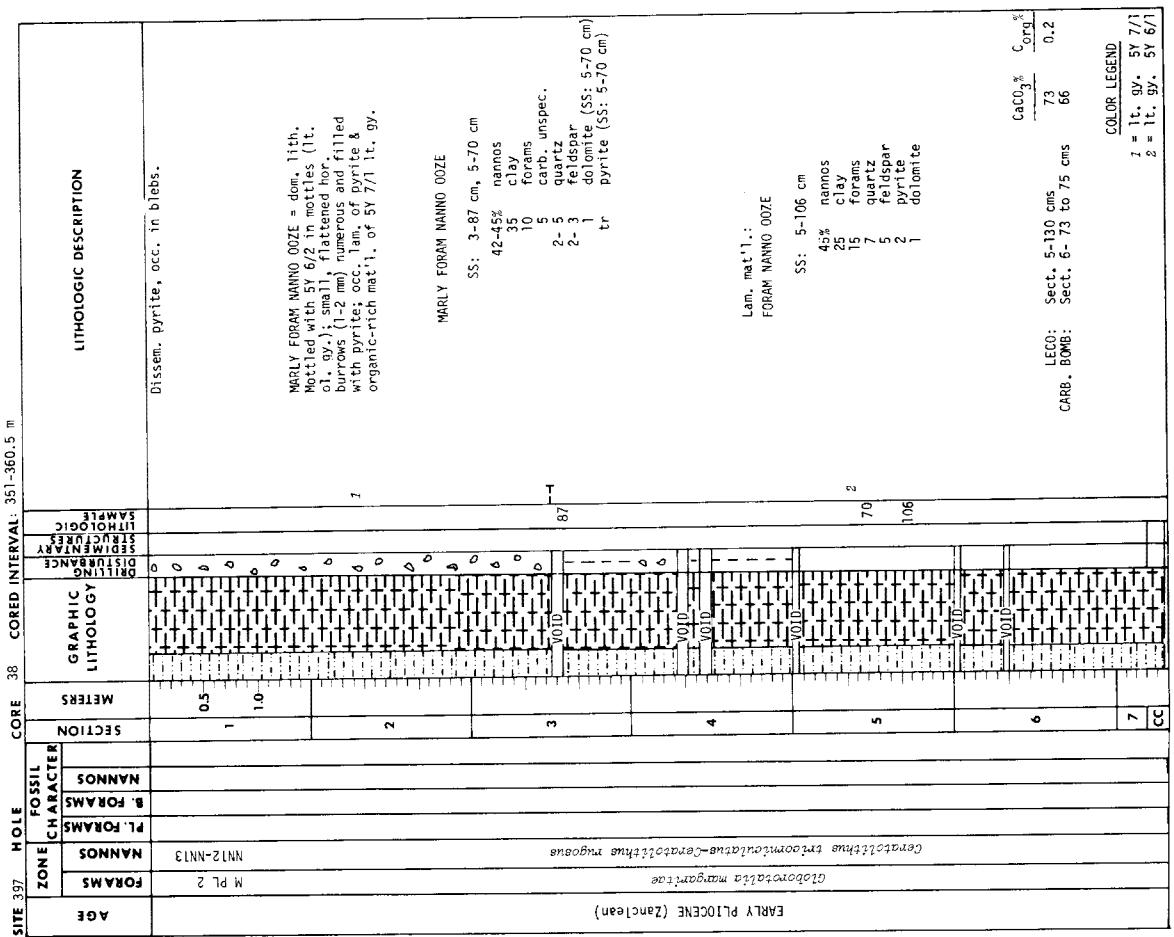
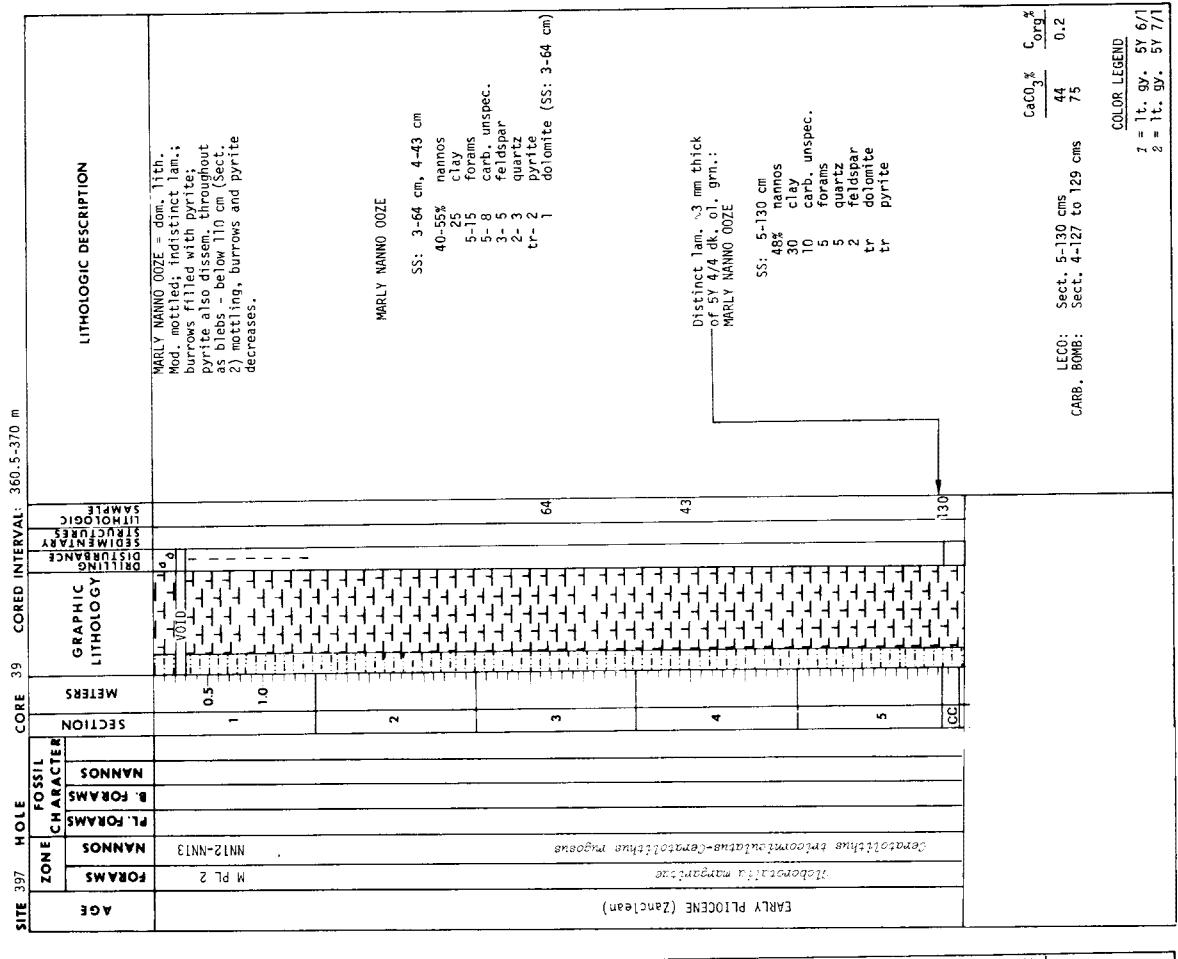


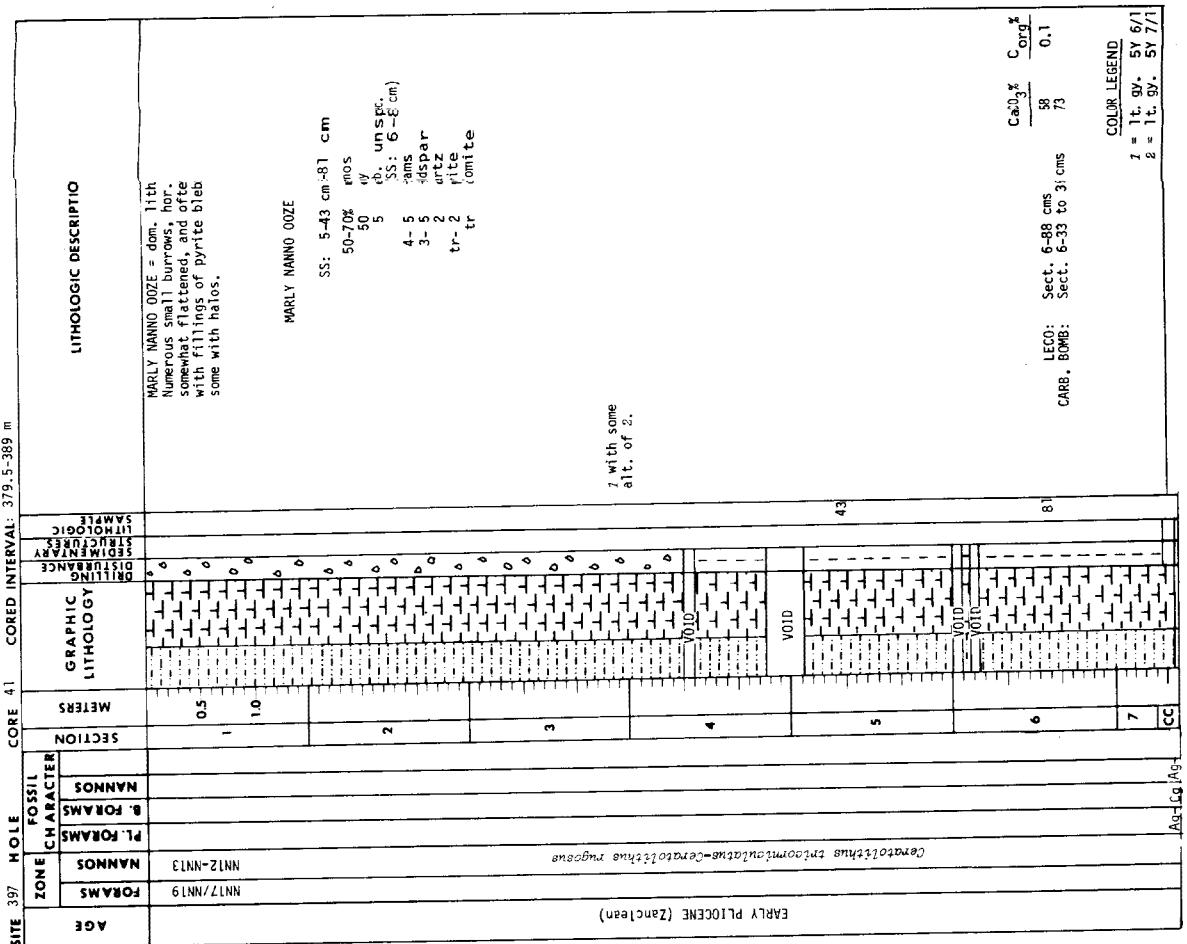




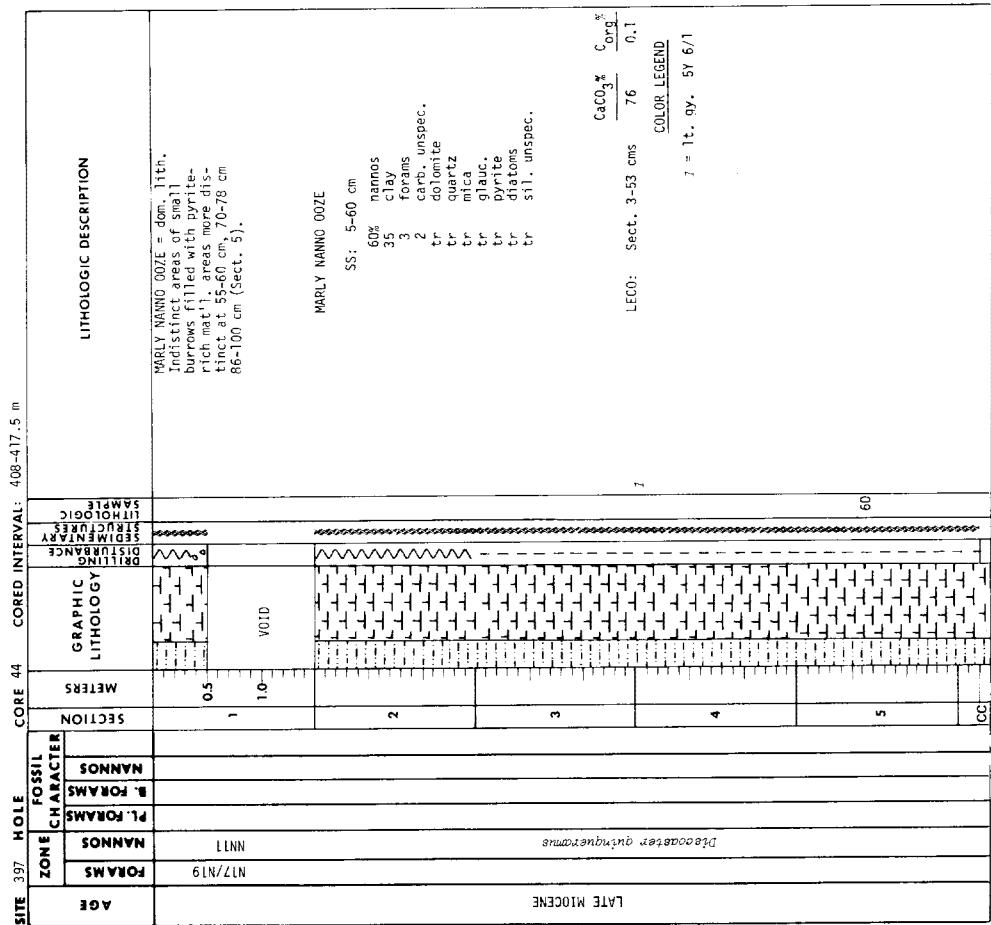
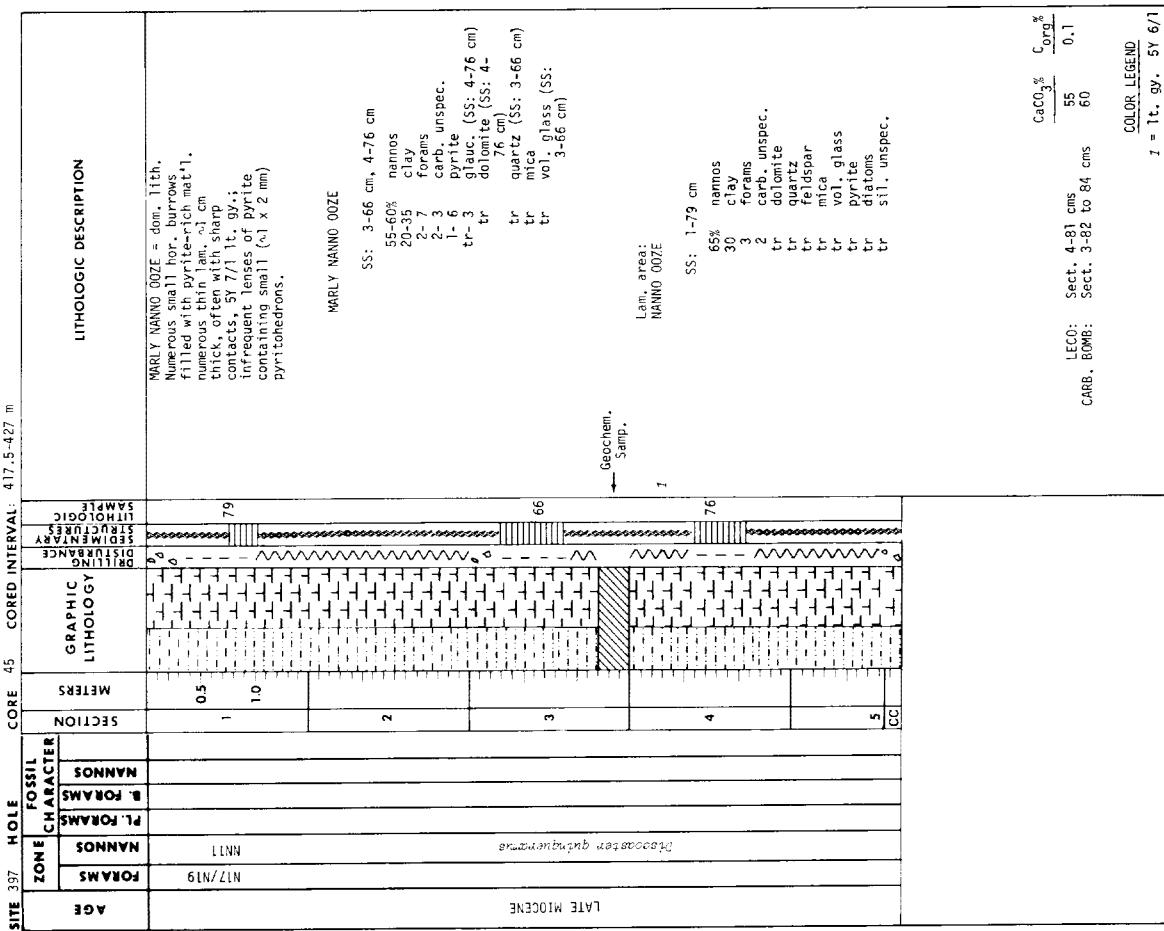
SITE 397		CORE 33		CORED INTERVAL: 303.5-313 m	
AGE	ZONE	FOLIATE CHARACTER	FOSSIL CHARACTER	METERS	SECTION
EARLY PLIOCENE (Zanclean)	FORAMS	PL. FORAMS	NANNO	0.5	1
OLIGOCENE/MIOCENE	FORAMS	B. FORAMS	NANNO	1	2
OLIGOCENE/MIOCENE	PL. FORAMS	PL. FORAMS	NANNO	10	3
OLIGOCENE/MIOCENE	PL. FORAMS	PL. FORAMS	NANNO	2	4
OLIGOCENE/MIOCENE	PL. FORAMS	PL. FORAMS	NANNO	92	52
LITHOLOGIC DESCRIPTION		LITHOLOGIC DESCRIPTION		LITHOLOGIC DESCRIPTION	
MARLY FORAM NANNO 00ZE		MARLY FORAM NANNO 00ZE		MARLY FORAM NANNO 00ZE	
Dissem. pyrite throughout.		Dissem. pyrite throughout.		Dissem. pyrite throughout.	
SAMPLE		SAMPLE		SAMPLE	
LITHOTECTONIC		LITHOTECTONIC		LITHOTECTONIC	
STRUCTURES		STRUCTURES		STRUCTURES	
SEDIMENTATION		SEDIMENTATION		SEDIMENTATION	
DISCUSSION		DISCUSSION		DISCUSSION	
INTERVALS		INTERVALS		INTERVALS	
STRUCTURE		STRUCTURE		STRUCTURE	
SEDIMENT		SEDIMENT		SEDIMENT	
ORGANIC		ORGANIC		ORGANIC	
CARB. BORH:		CARB. BORH:		CARB. BORH:	
LECO:		LECO:		LECO:	
Sect. 3-91 cms		Sect. 3-91 cms		Sect. 3-91 cms	
4.80 to 82 cms		4.80 to 82 cms		4.80 to 82 cms	
7 & 2		7 & 2		7 & 2	
64		64		64	
70		70		70	
0.3		0.3		0.3	
COLOR LEGEND		COLOR LEGEND		COLOR LEGEND	
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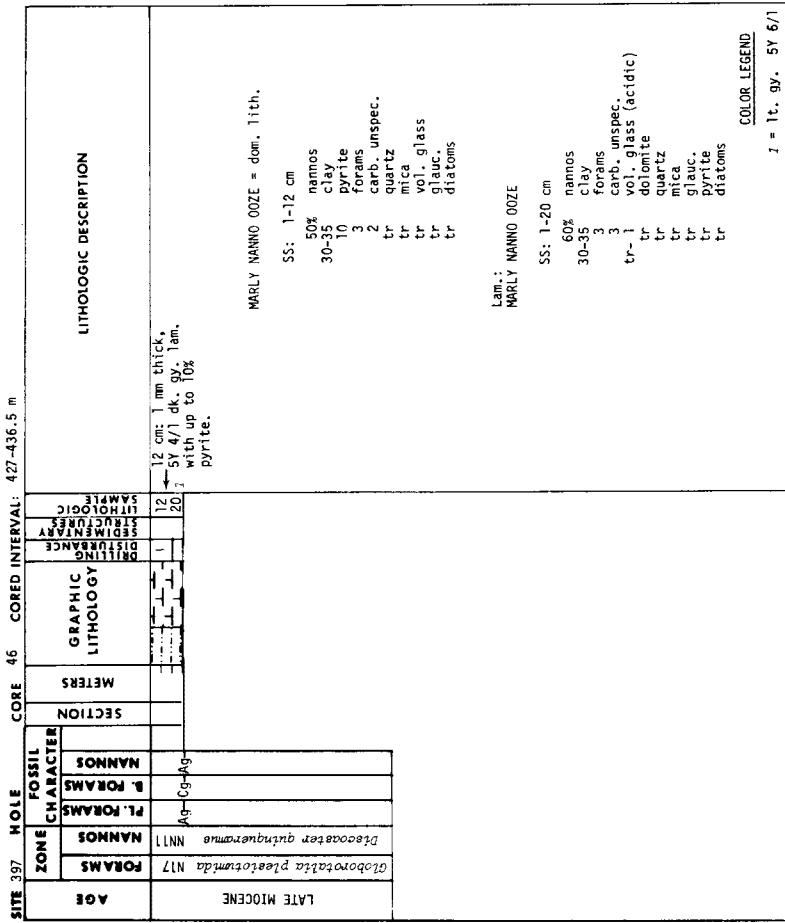
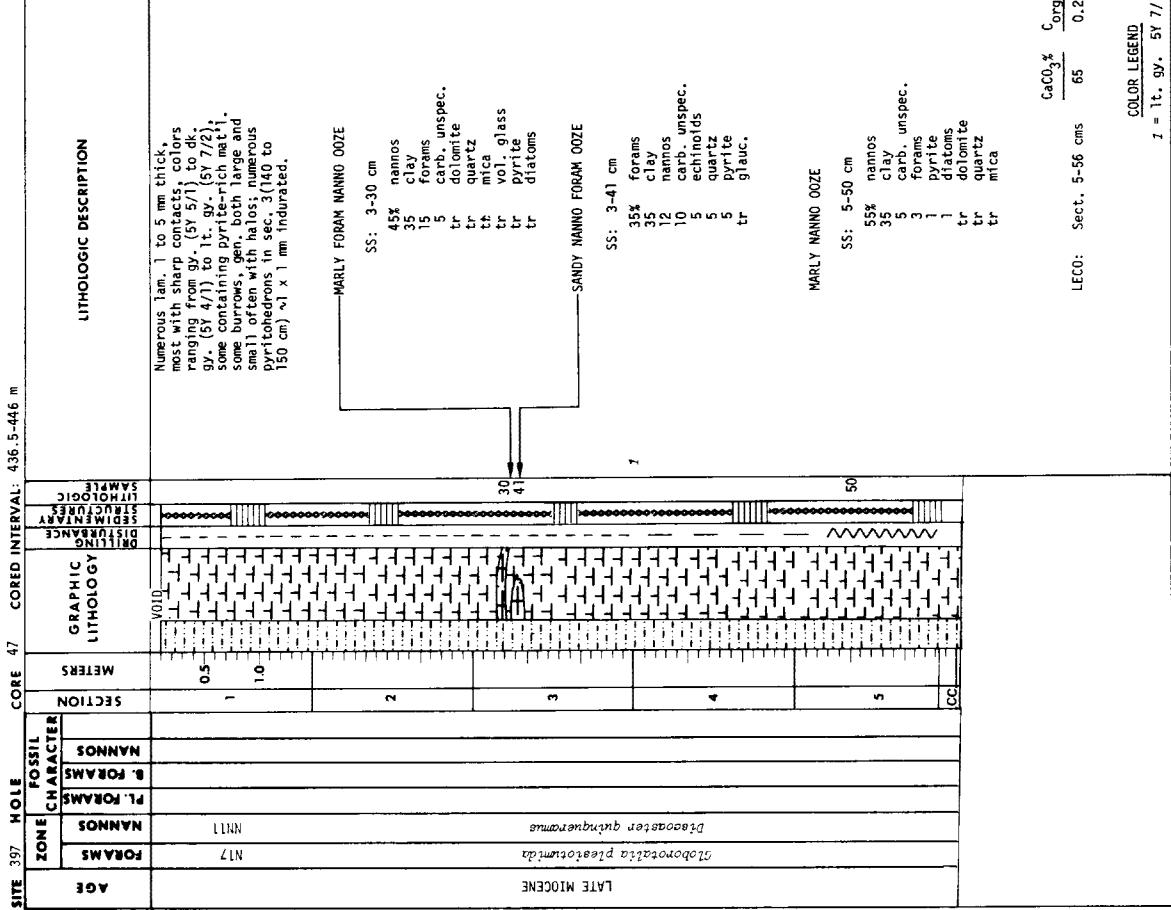






SITE : 397		HOLE #12		CORE #12		CORED INTERVAL: 389-398.5 m	
ZONE		FOSSIL CHARACTER		SECTION		SAMPLE	
AGC	FORMATS	PL. FORMS	b. FORMAMS	METERS	GRAPHIC LITHOLOGY	STRUCTURES	LITHOLOGIC DESCRIPTION
NT7/NT19	NaNanoS	NaNanoS	b. FORMAMS	0.5	VOID	STRUCTURES	MARLY NANNO Ooze = dom. lith. Numerous small burrows, often filled with pyrite.
Geopetalolithus tricostatus-G, nungoane NT12- NT13	NaNanoS	NaNanoS	PL. FORMAMS	1.0	-	STRUCTURES	SS: 1-112, 130 cm 55-60% nannos 25-40 clay tr- 5 quartz 3 carb. unspc.
Ag-In	Ag-In	Ag-In	Ag-In	1.0	-	STRUCTURES	MARLY NANNO Ooze
Ag-In	Ag-In	Ag-In	Ag-In	1.12	-	STRUCTURES	SS: 1-112, 130 cm 55-60% nannos 25-40 clay tr- 5 quartz 3 carb. unspc.
Ag-In	Ag-In	Ag-In	Ag-In	1.30	-	STRUCTURES	MARLY NANNO Ooze
Ag-In	Ag-In	Ag-In	Ag-In	1 & 2	VOID	STRUCTURES	2 pyrite 1 diatoms (SS: 1-130 cm) tr-mica 1 glauc tr-dolomite
Ag-In	CC	CC	CC	2	-	STRUCTURES	LARGE BURROW FILLED WITH GLAUC. AND PYRITE IN CC.
Ag-In	CC	CC	CC			LECO: Sect. 1-130 cms	CaCO <sub>3</sub> %
Ag-In	CC	CC	CC			CARB. BOMB: Sect. 1-112 to 114 cms	Org.%
							Legend
						z = lt. SV	SY 6/1
						z = lt. SV	SY 7/1

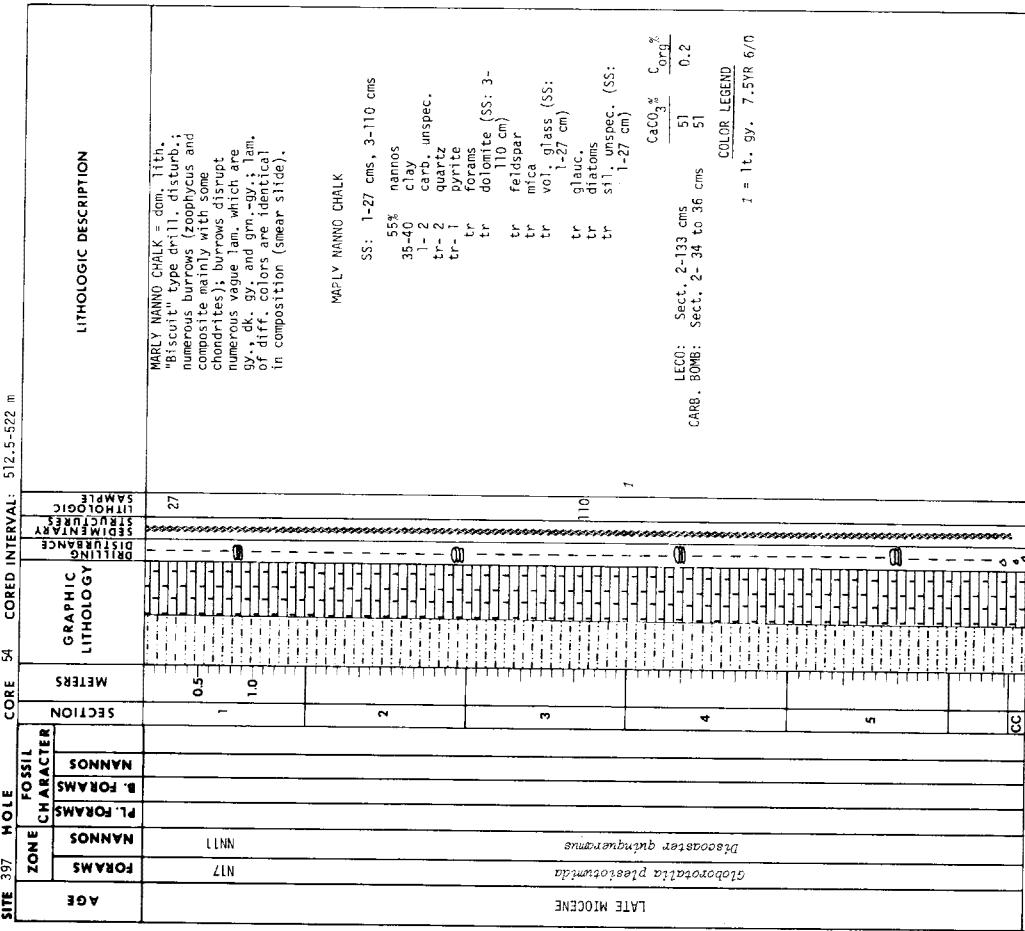
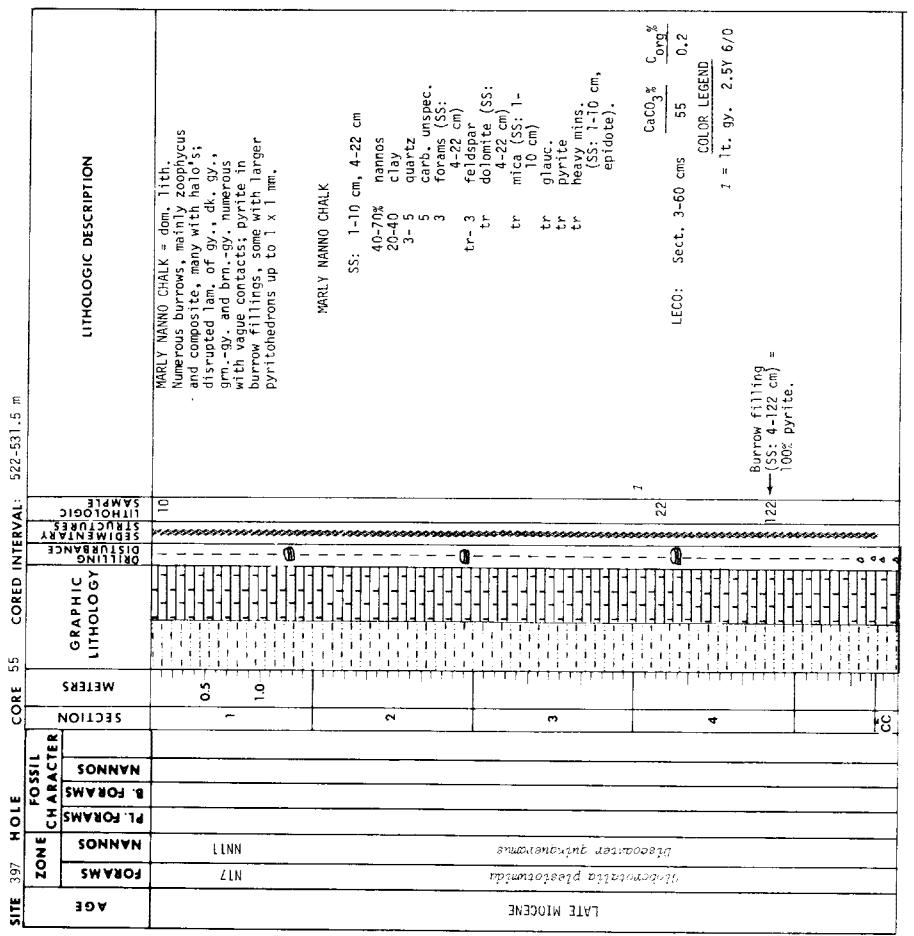


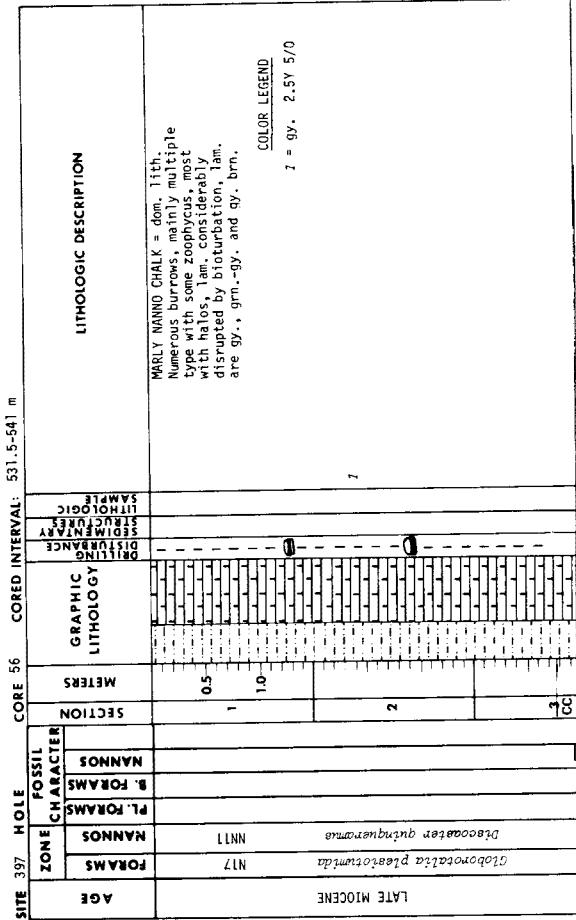
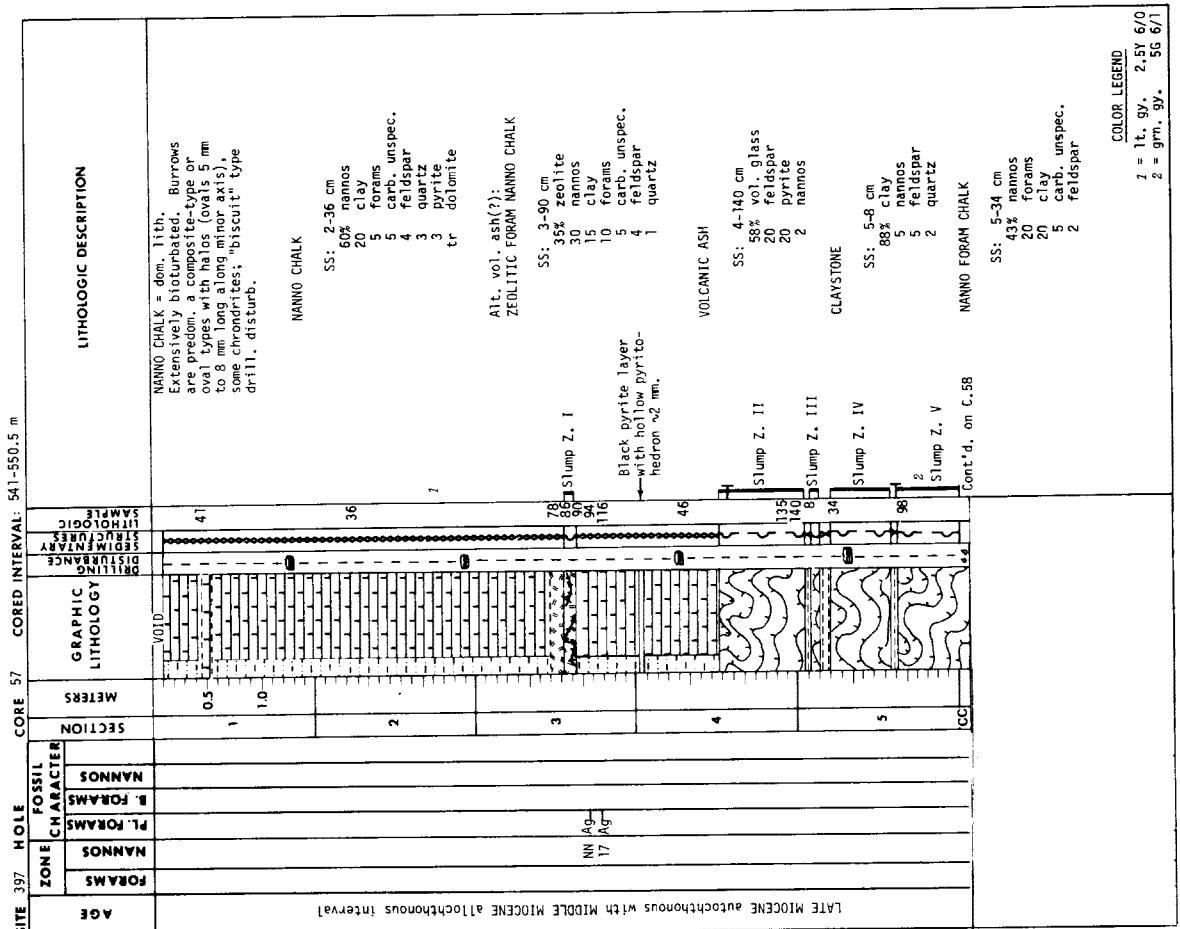


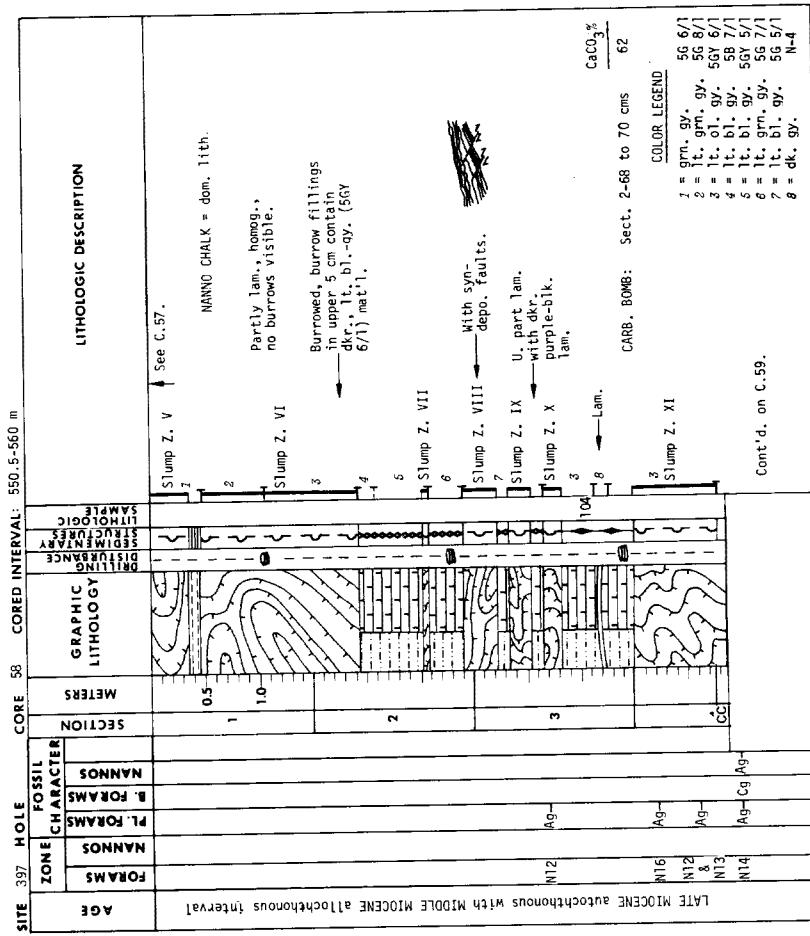
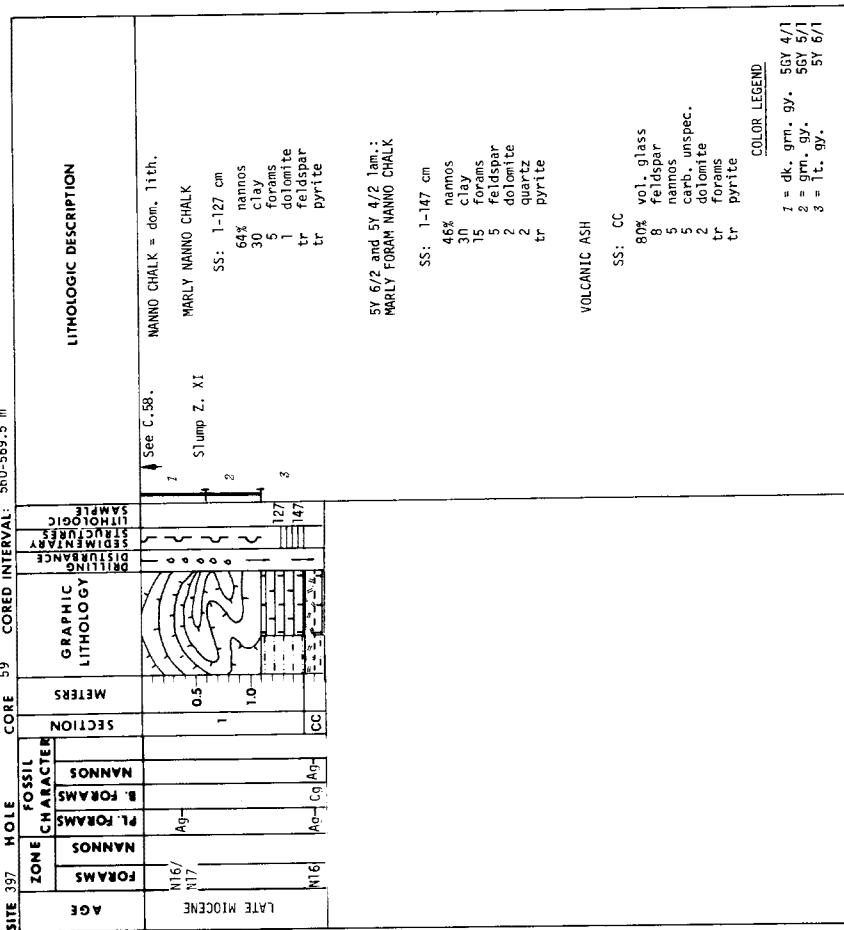
**COLOR LEGEND**  
**1 = lt. gy. SY 7/1**

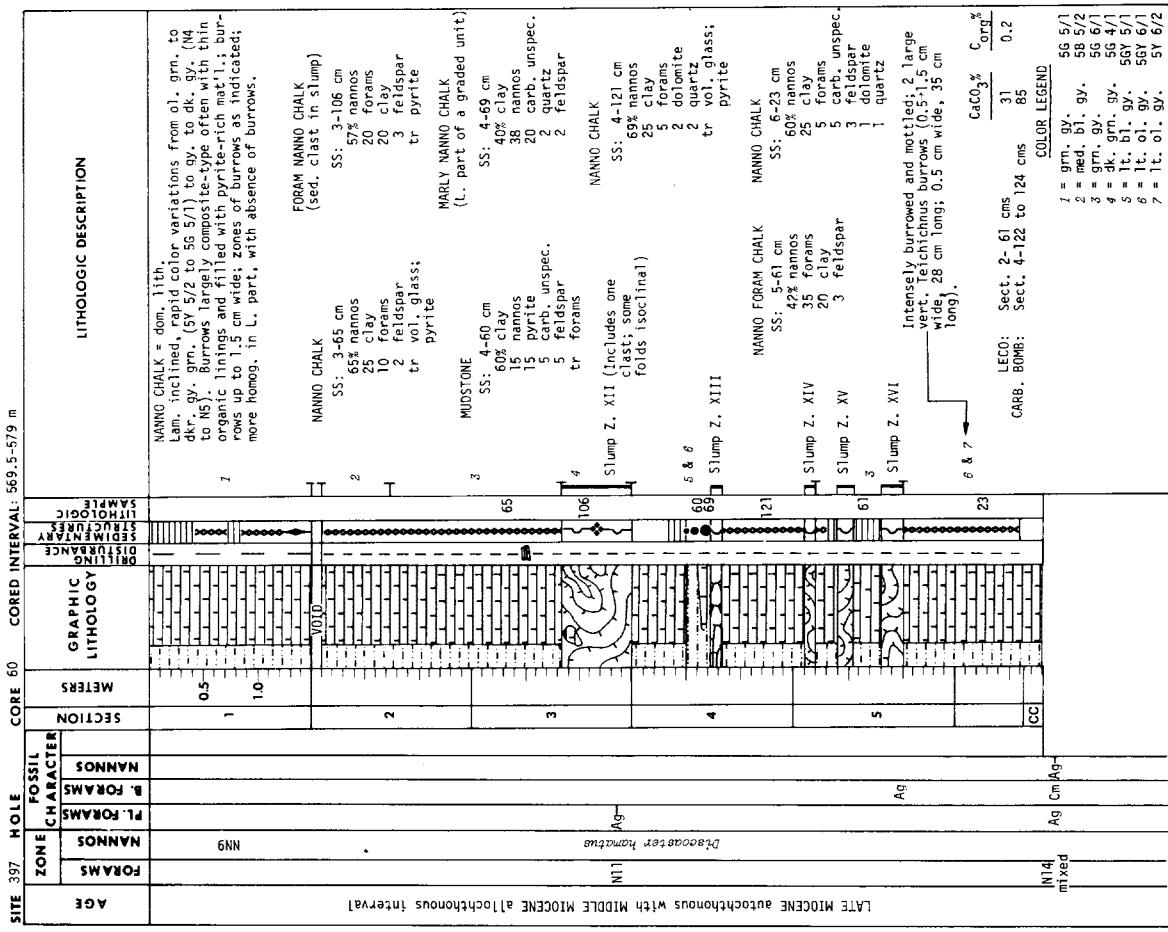
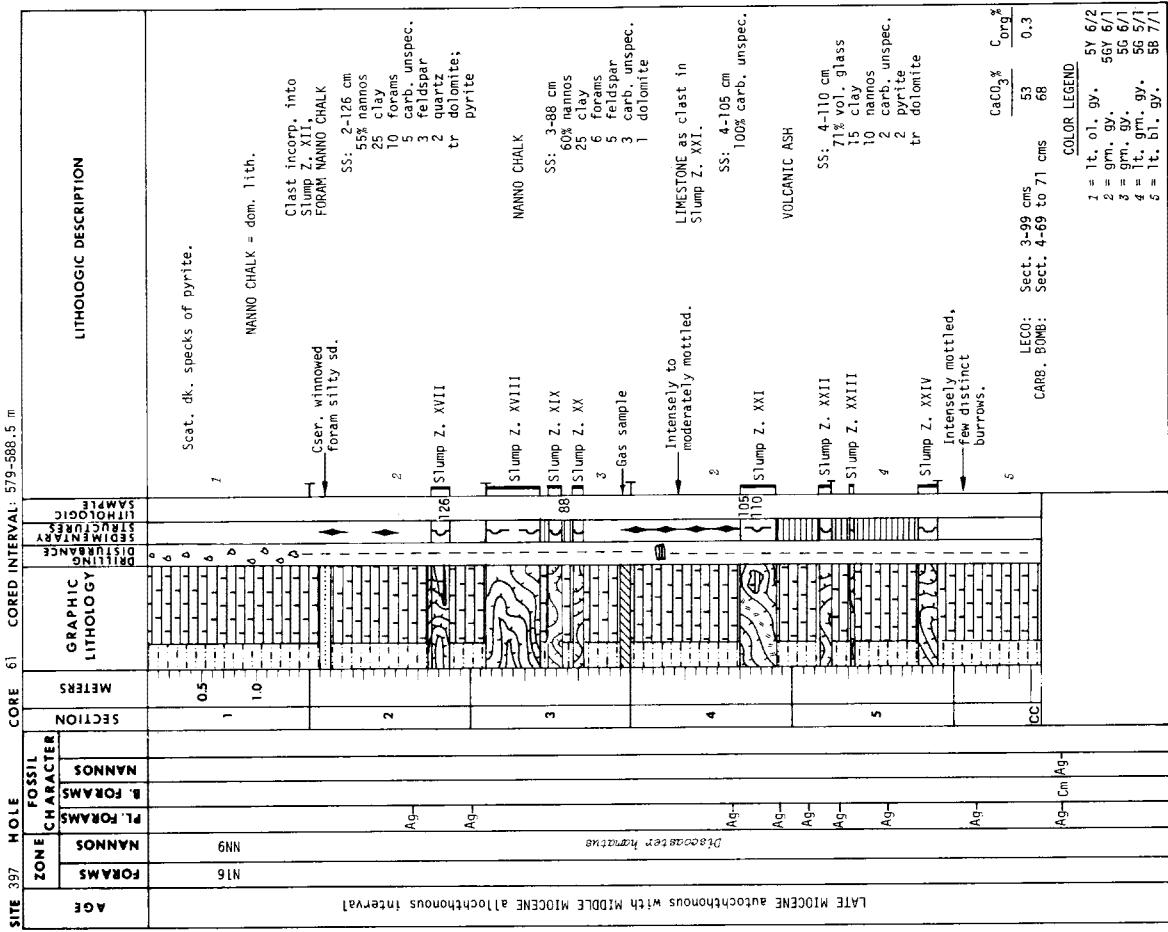
**LECO:** Sect. 5-56 cms  $\frac{\text{CaCO}_3\%}{65} \frac{\text{C}_\text{org}\%}{0.2}$

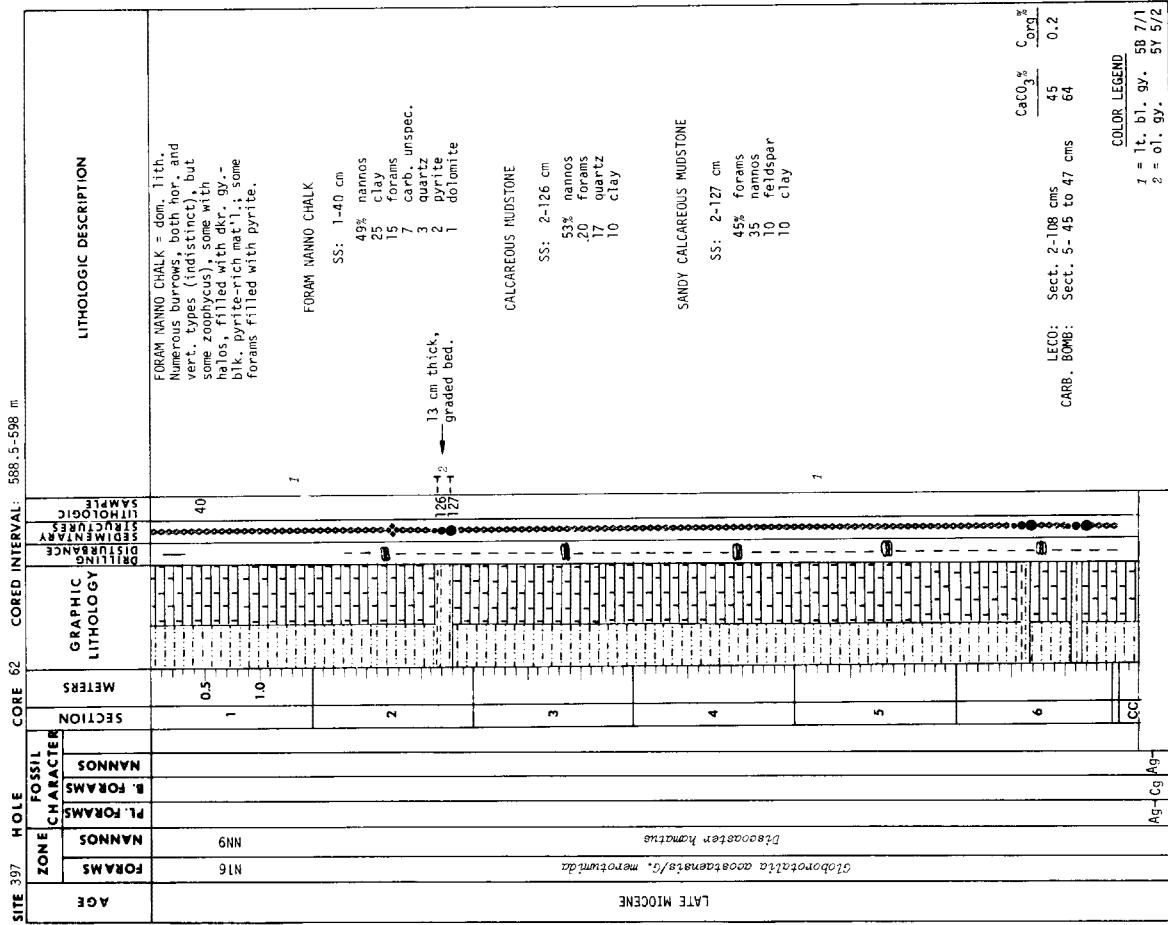
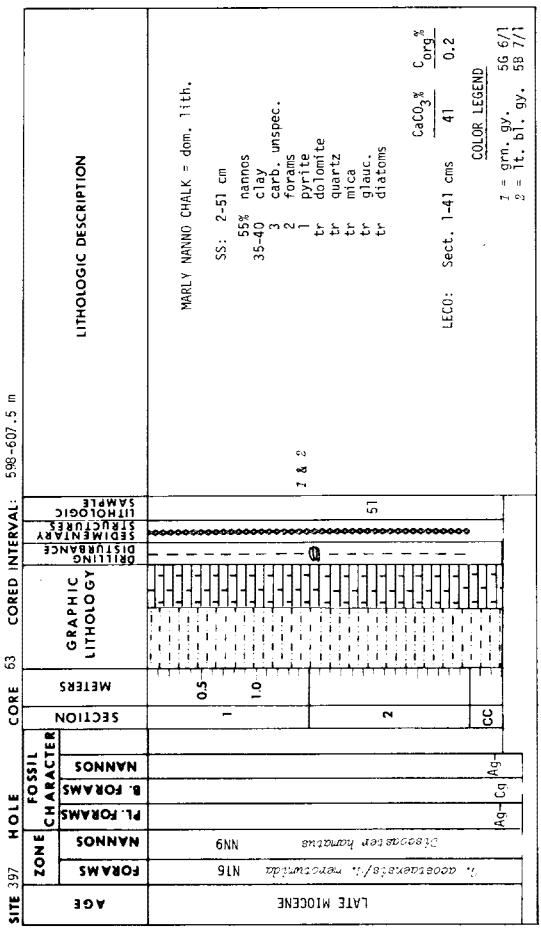


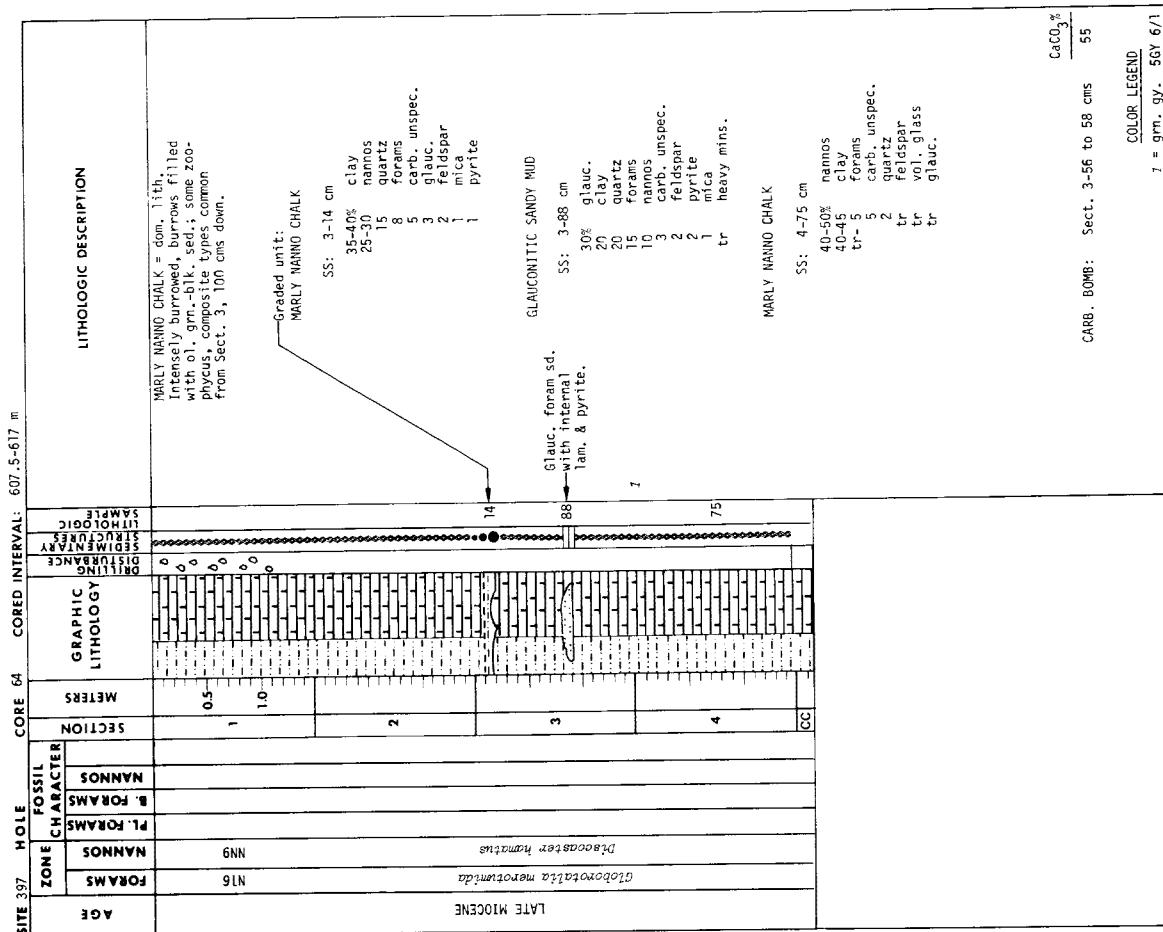
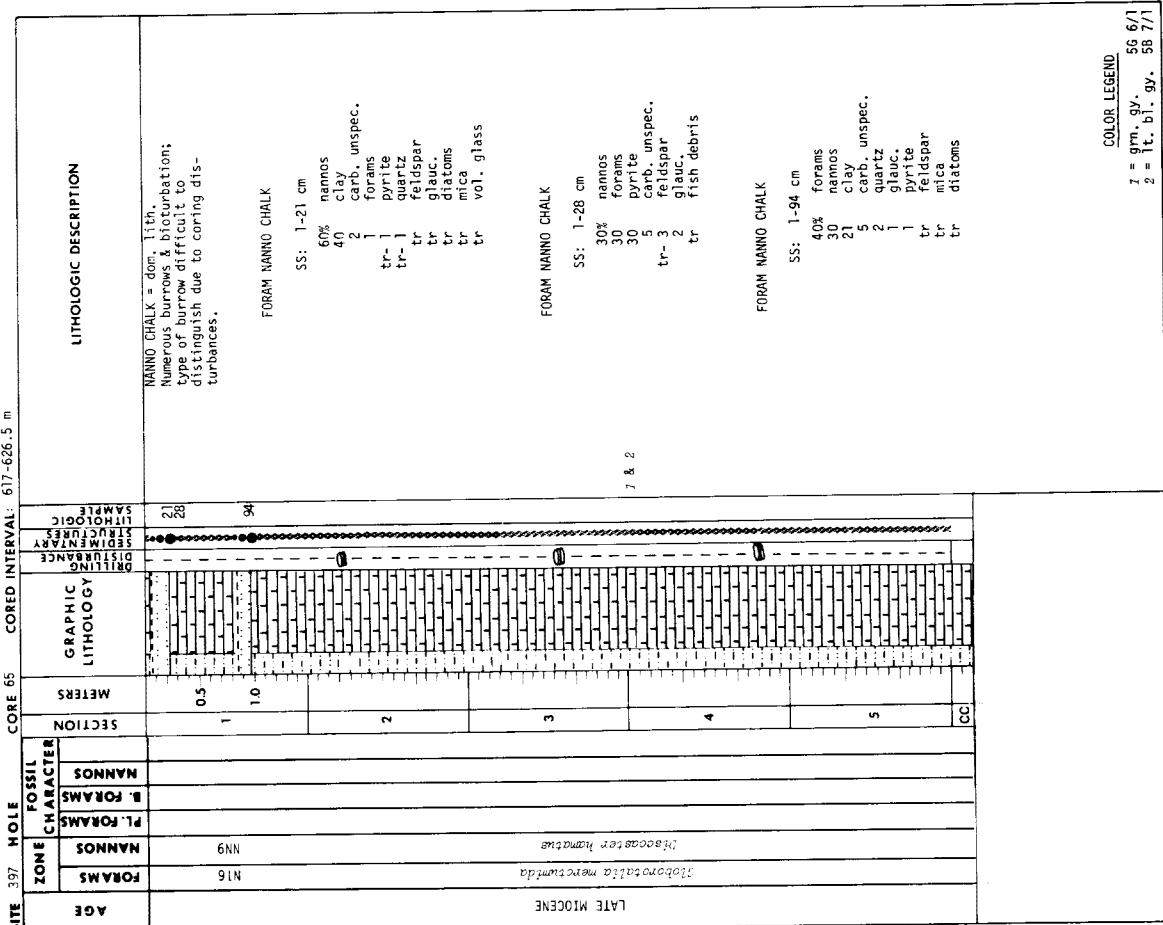


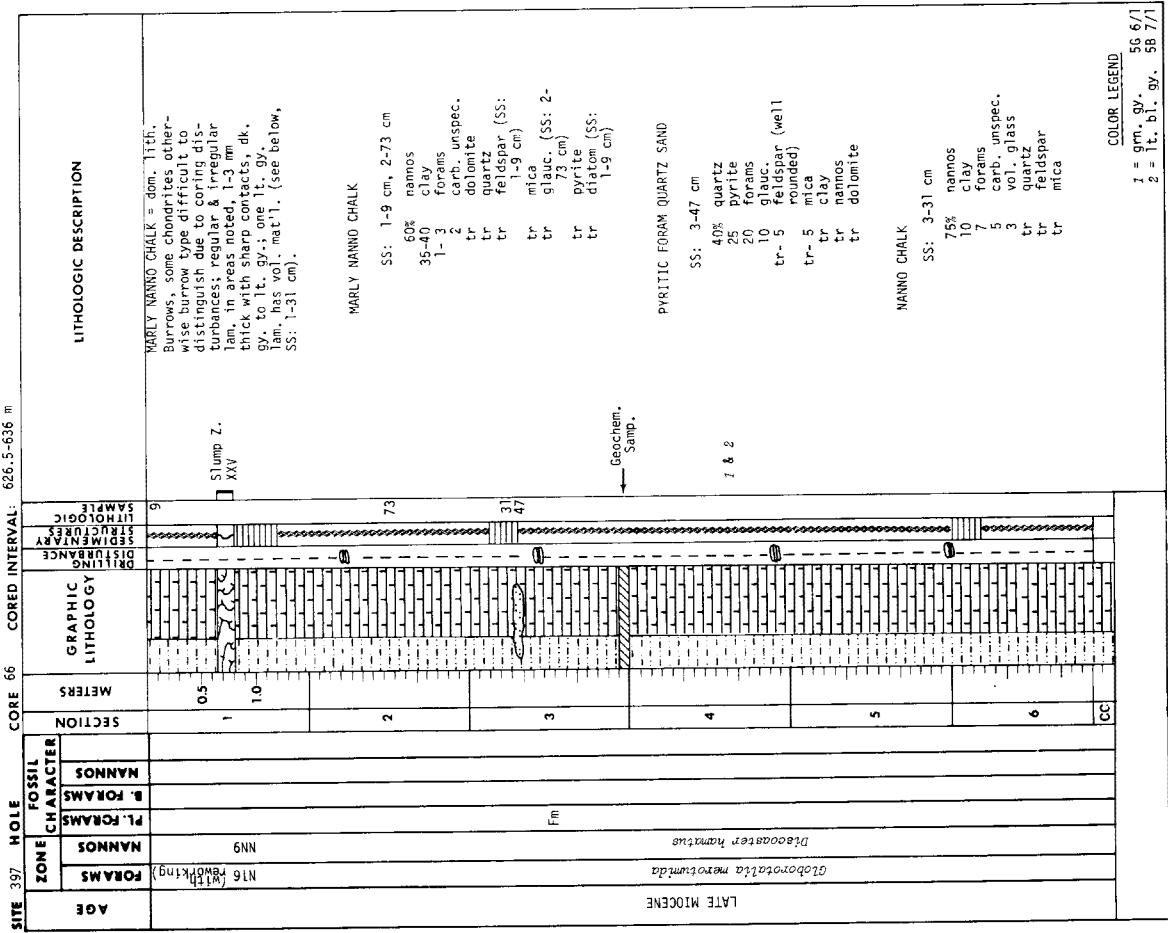
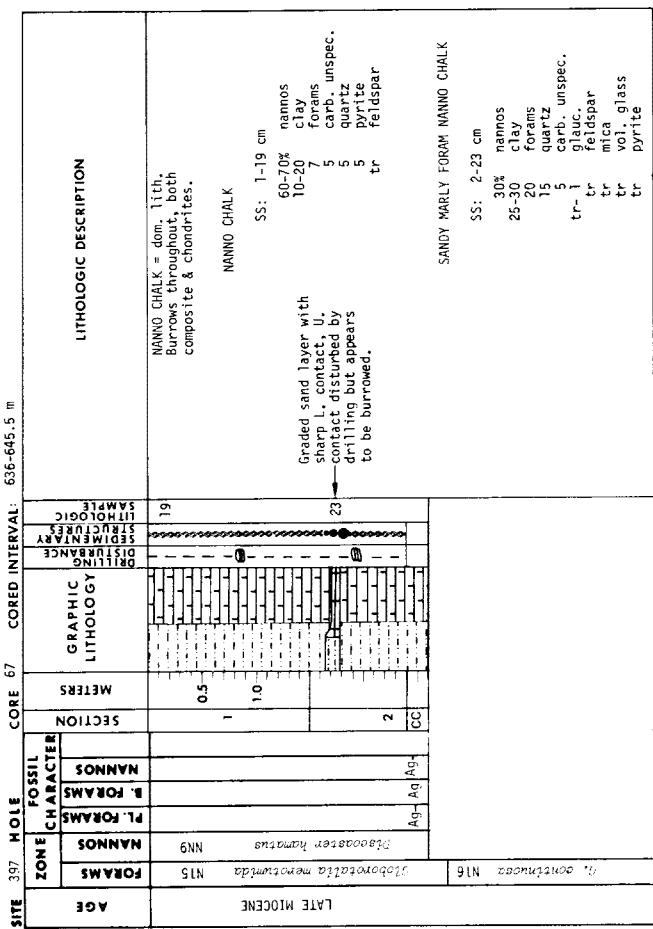


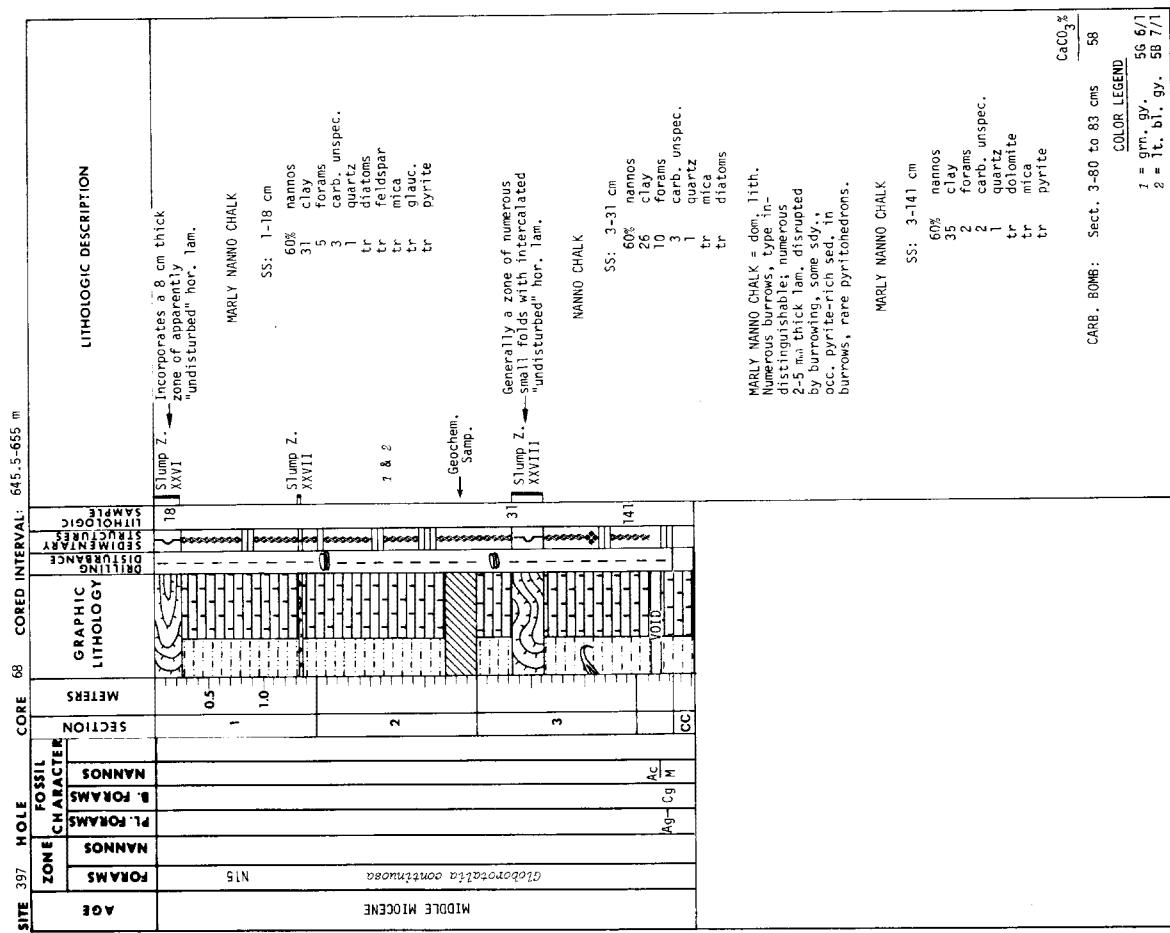
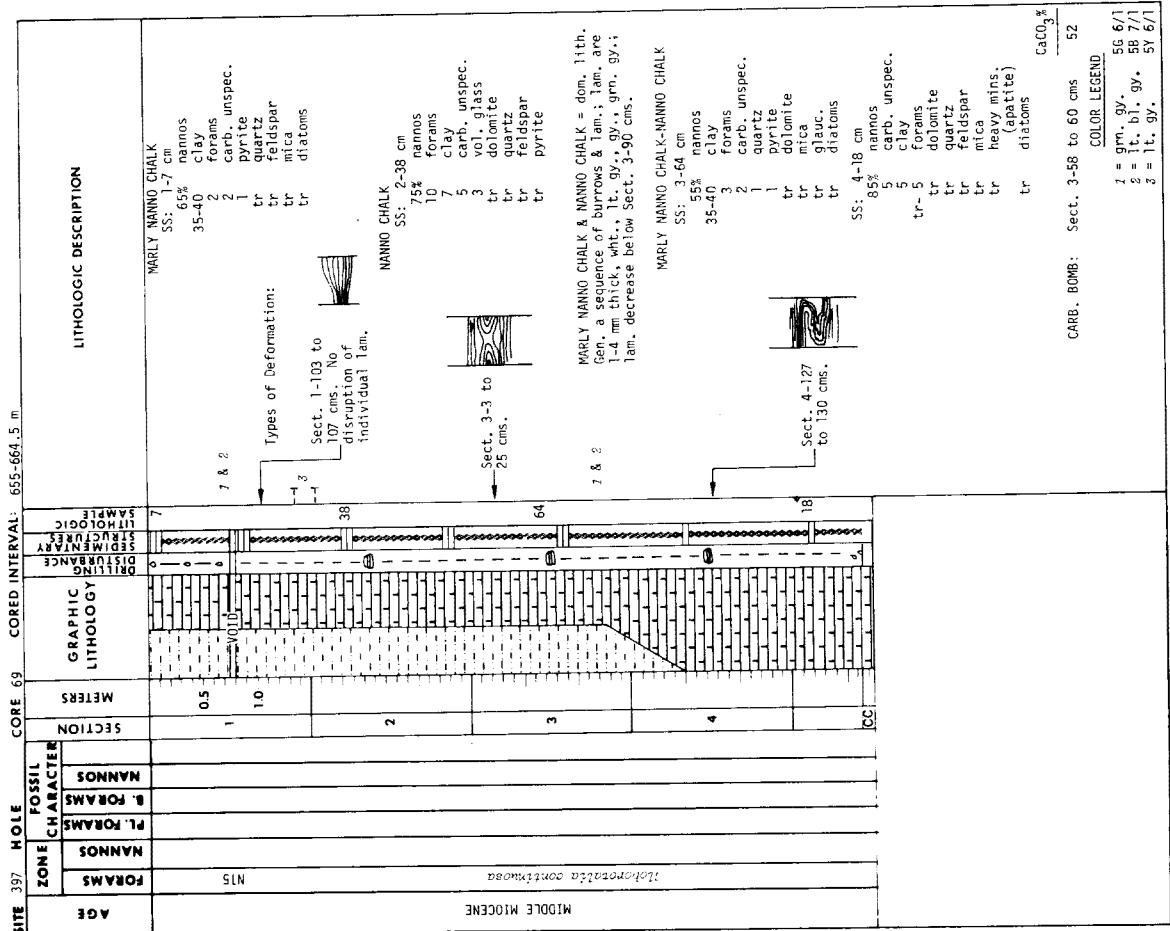


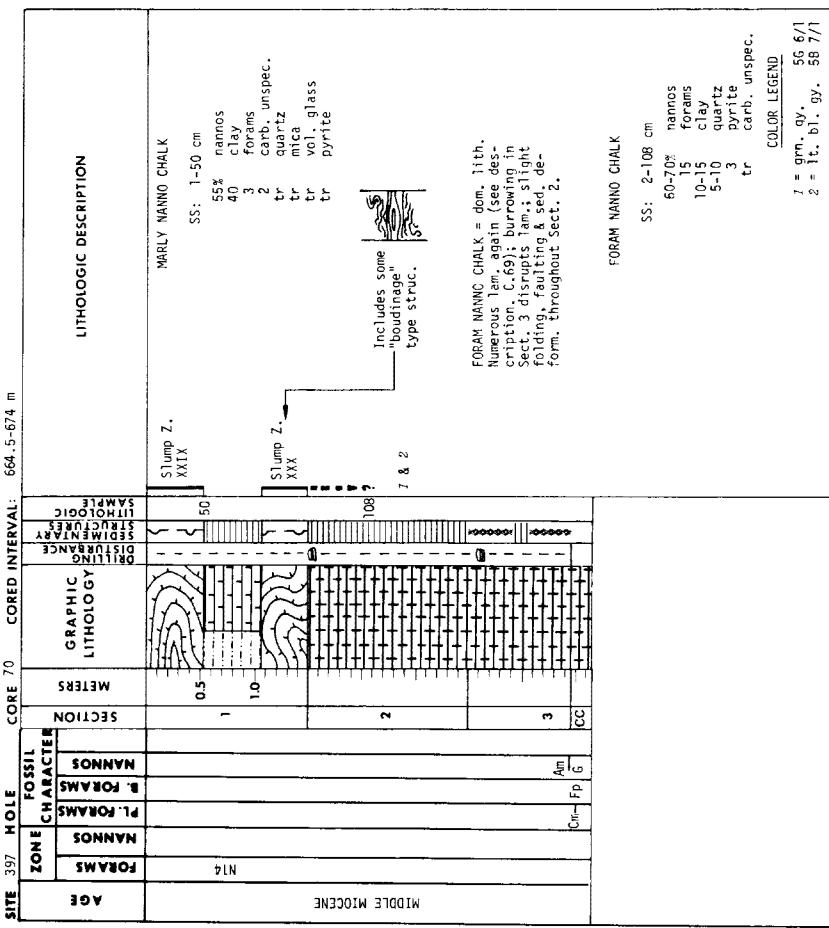
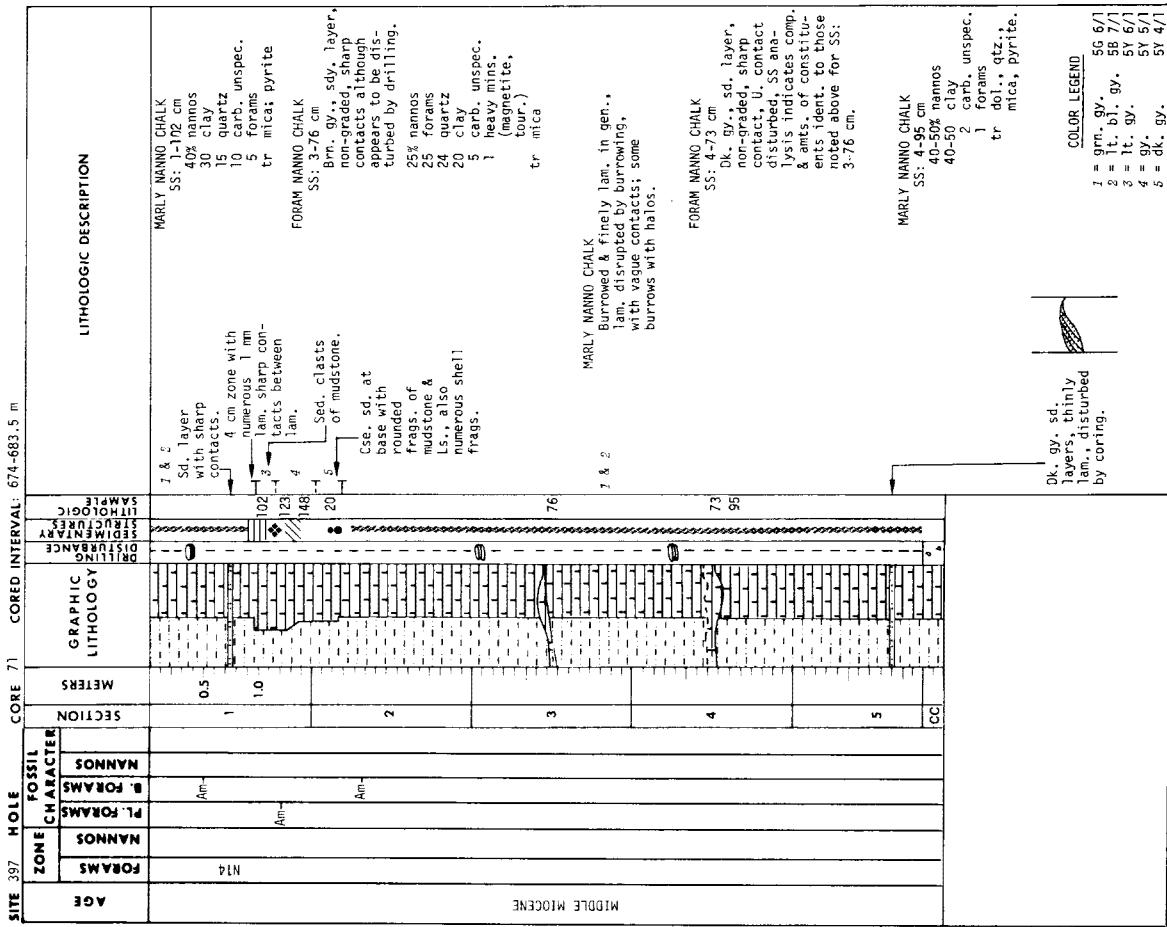


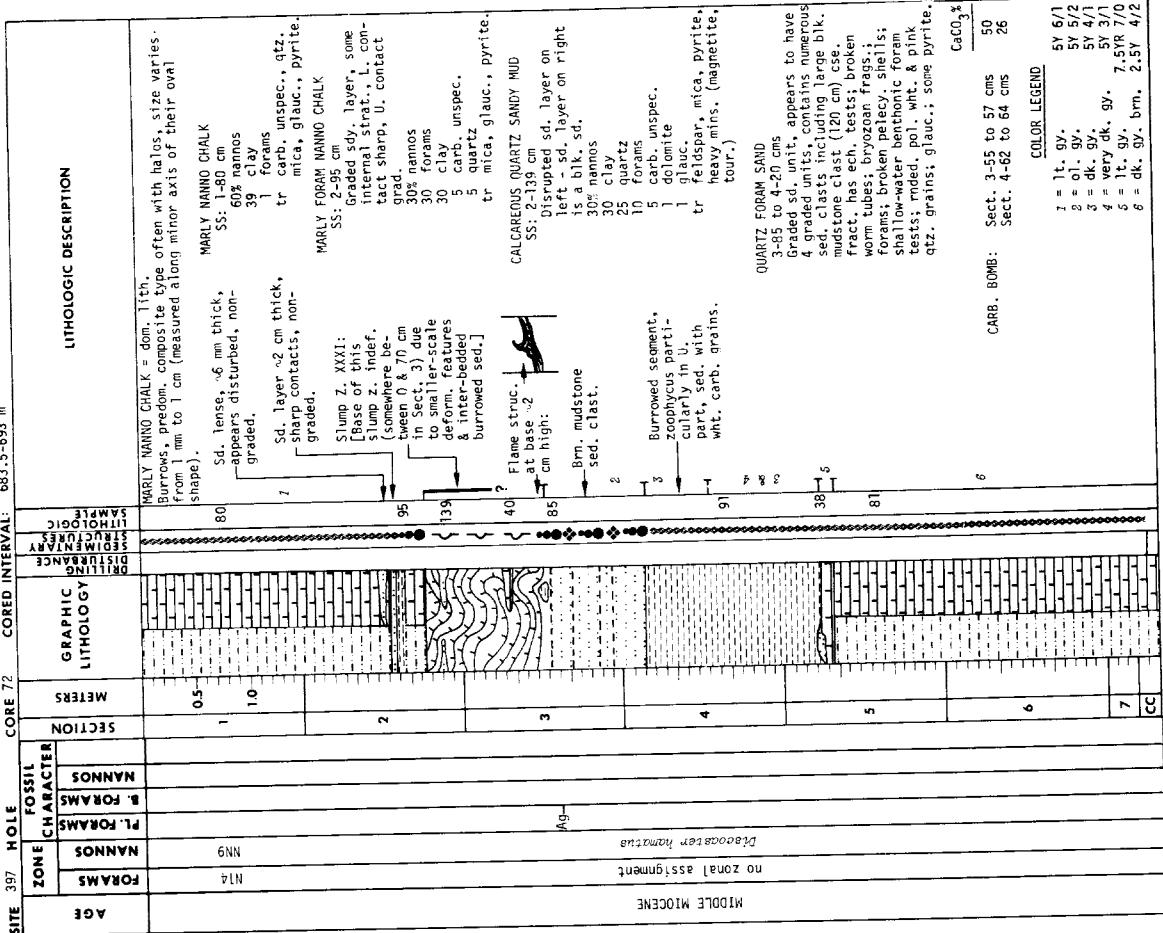
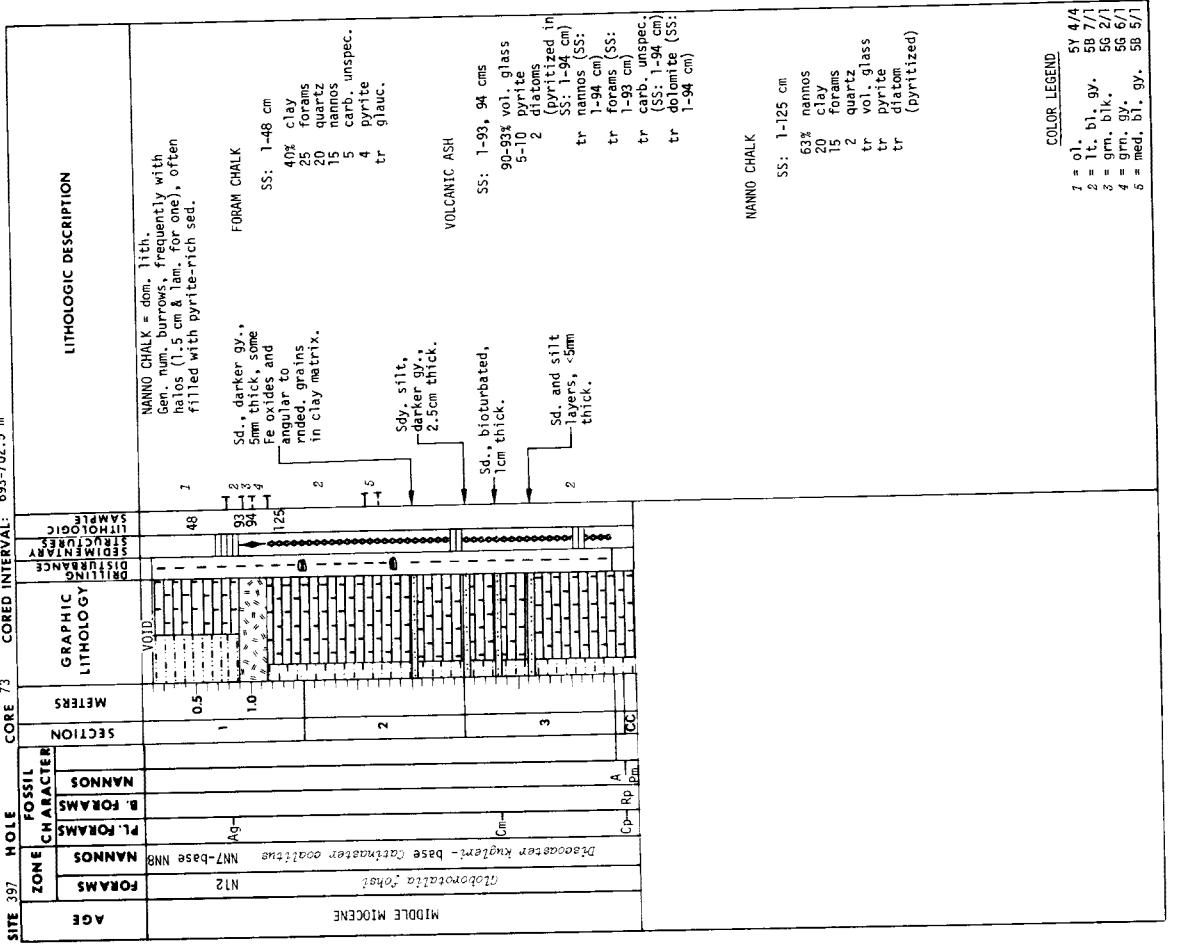


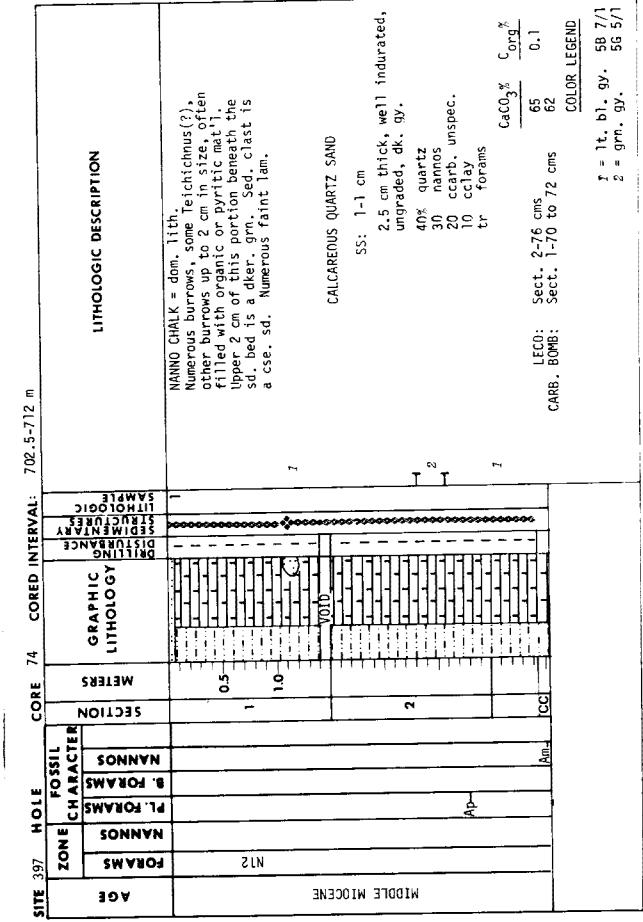
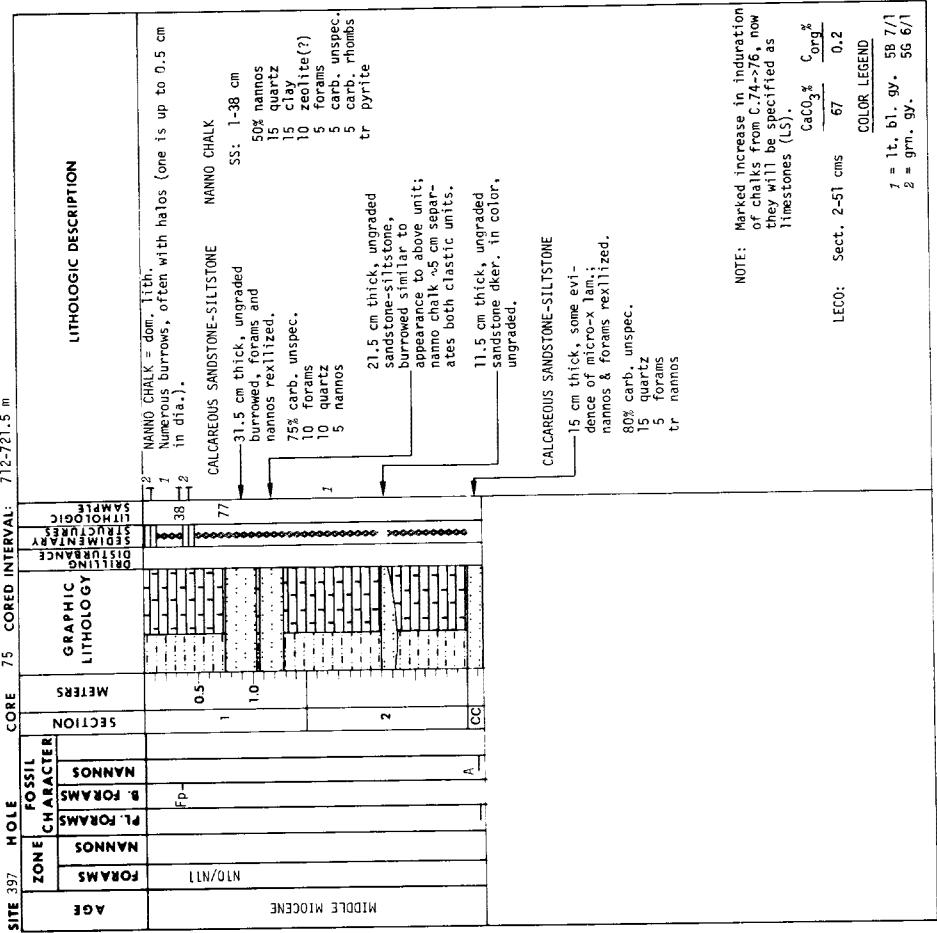






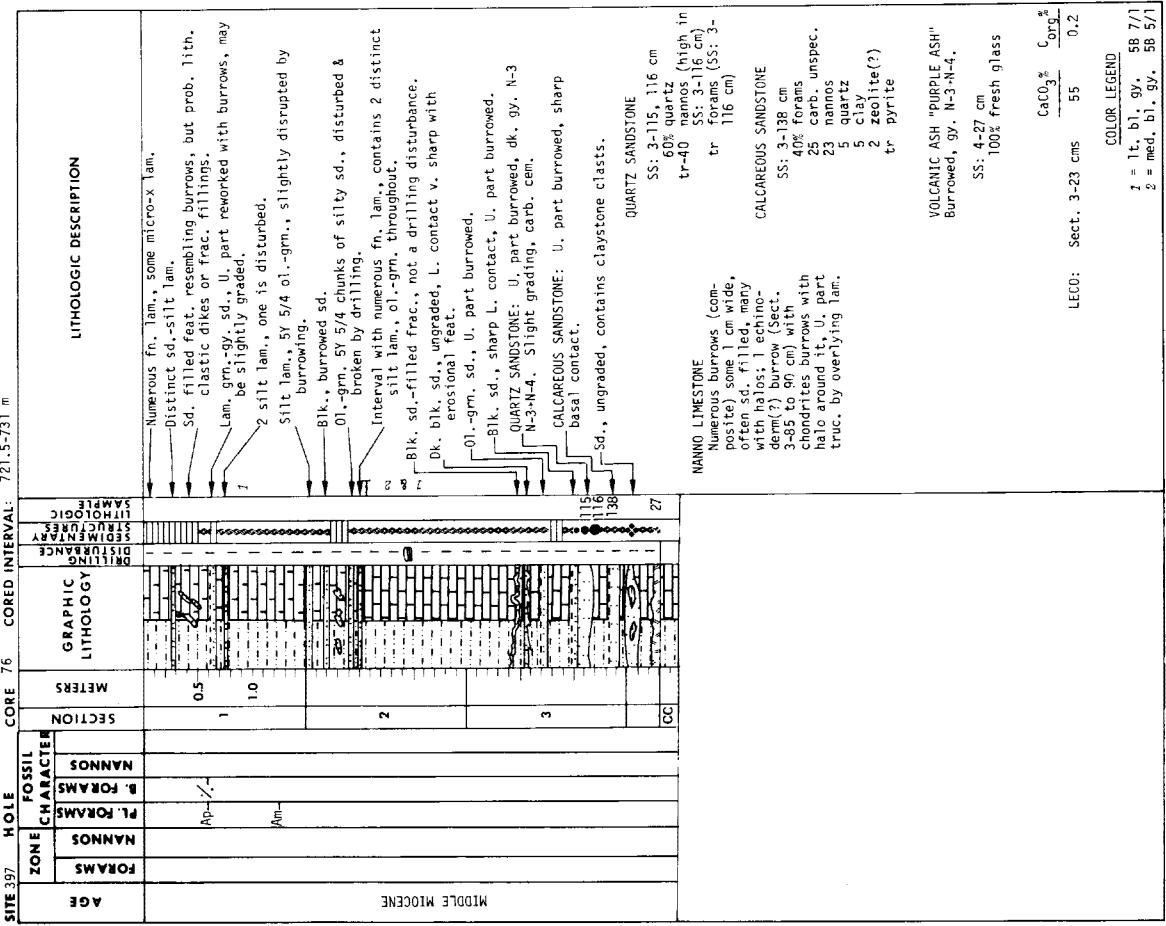
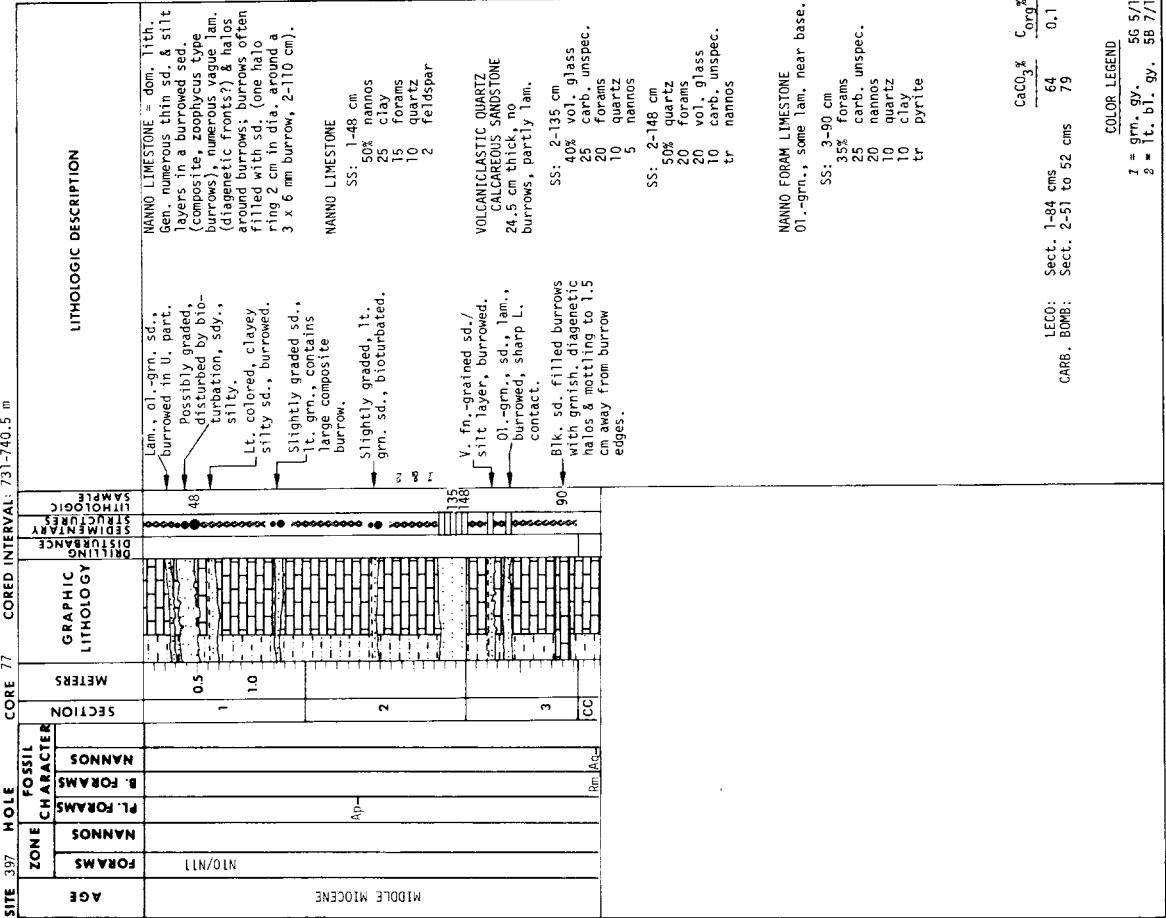






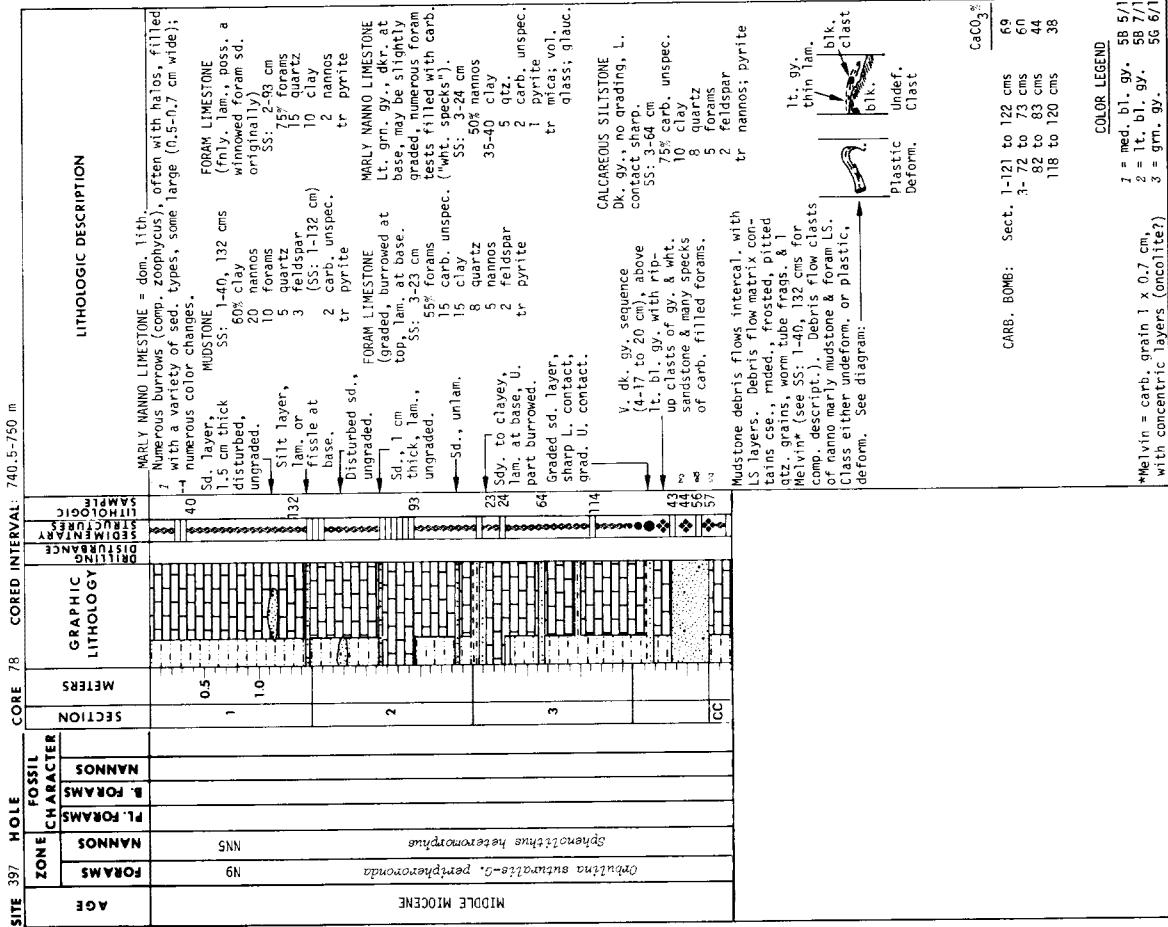
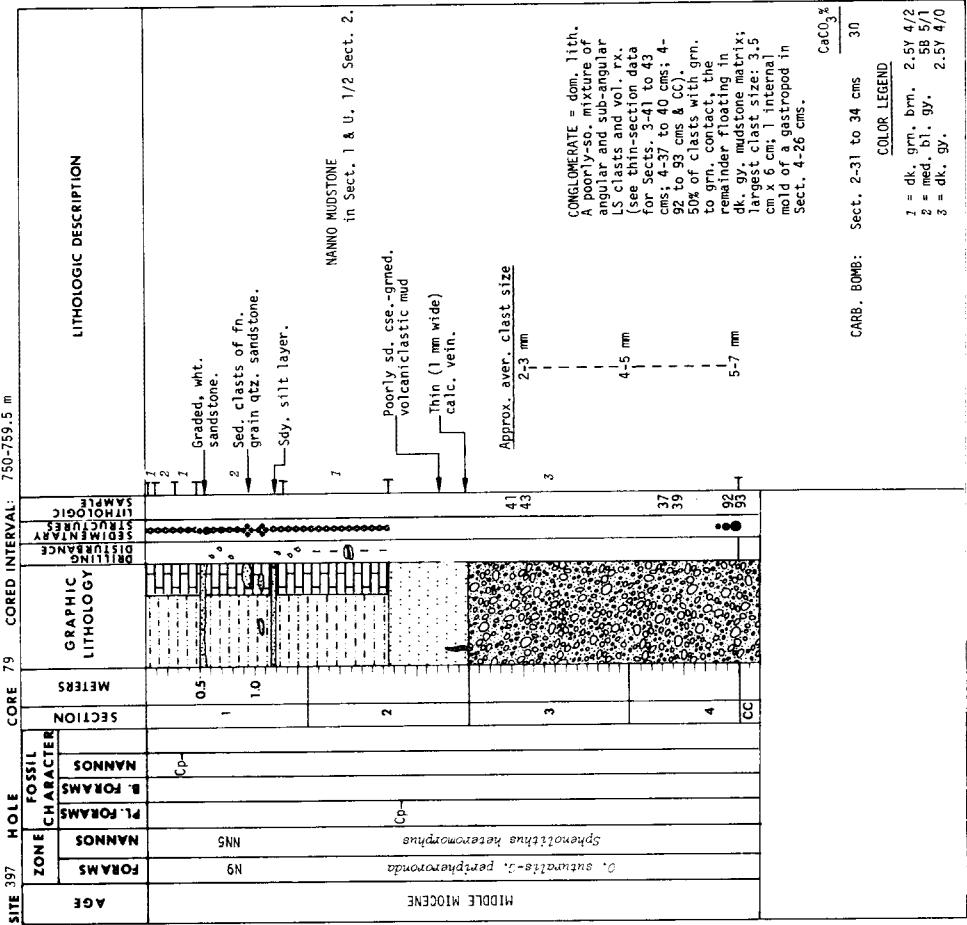
	<u>COLOR</u>	<u>LEGEND</u>
$\text{CaCO}_3\%$	$\text{C}_{\text{org}}\%$	
-51 cms	67	0.2

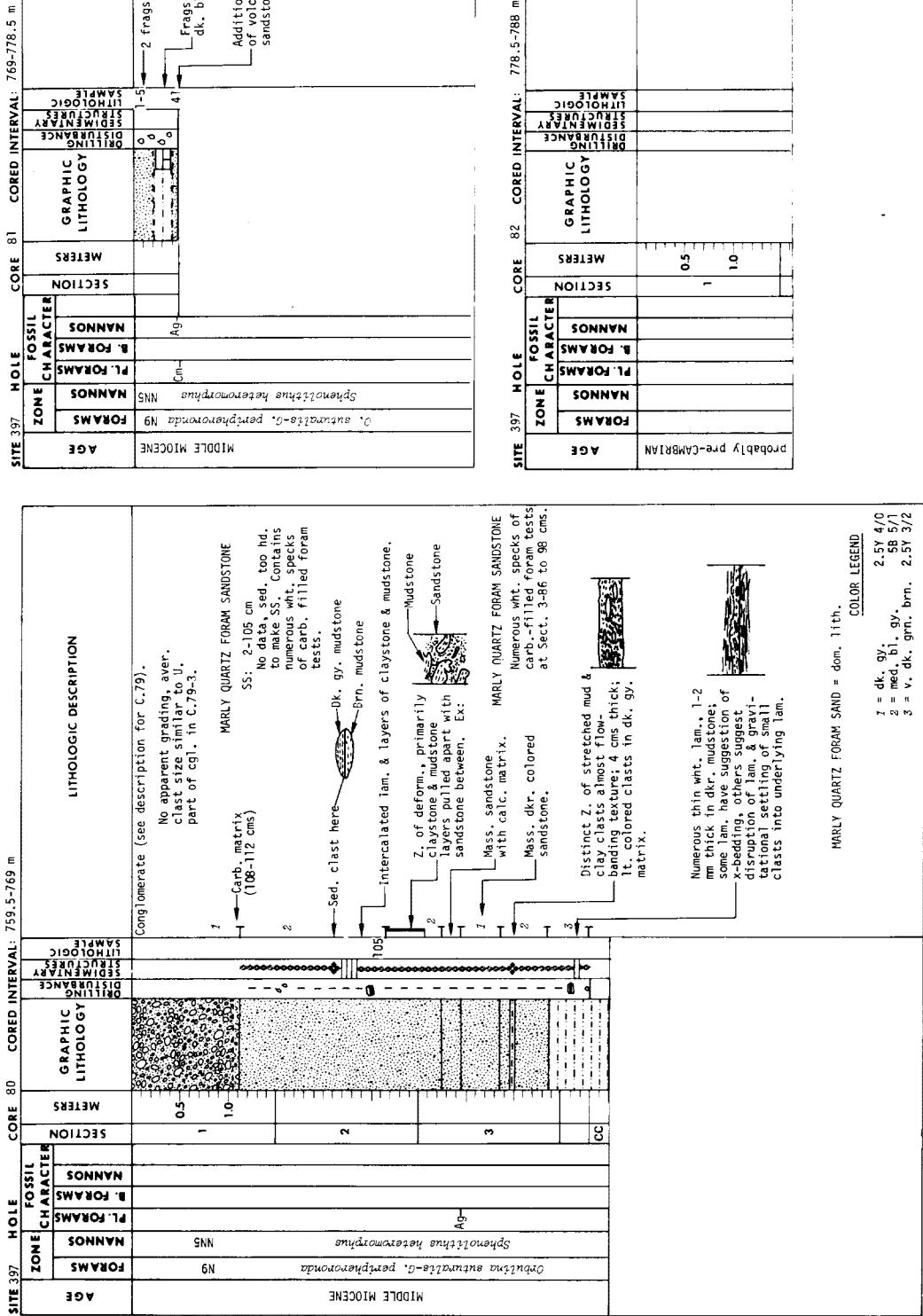
LECO: Sect. 2-



LEO:	Sect. 3-23 cms	$\frac{\text{CaCO}_3\%}{\text{Org}\%}$	$\frac{\text{CaCO}_3\%}{\text{Org}\%}$
CARB. BOMB:	Sect. 2-51 to 52 cms	64/79	0.1

COLOR LEGEND  
1 = lt. bl. gy. 58 7/1  
2 = med. bl. gy. 58 5/1





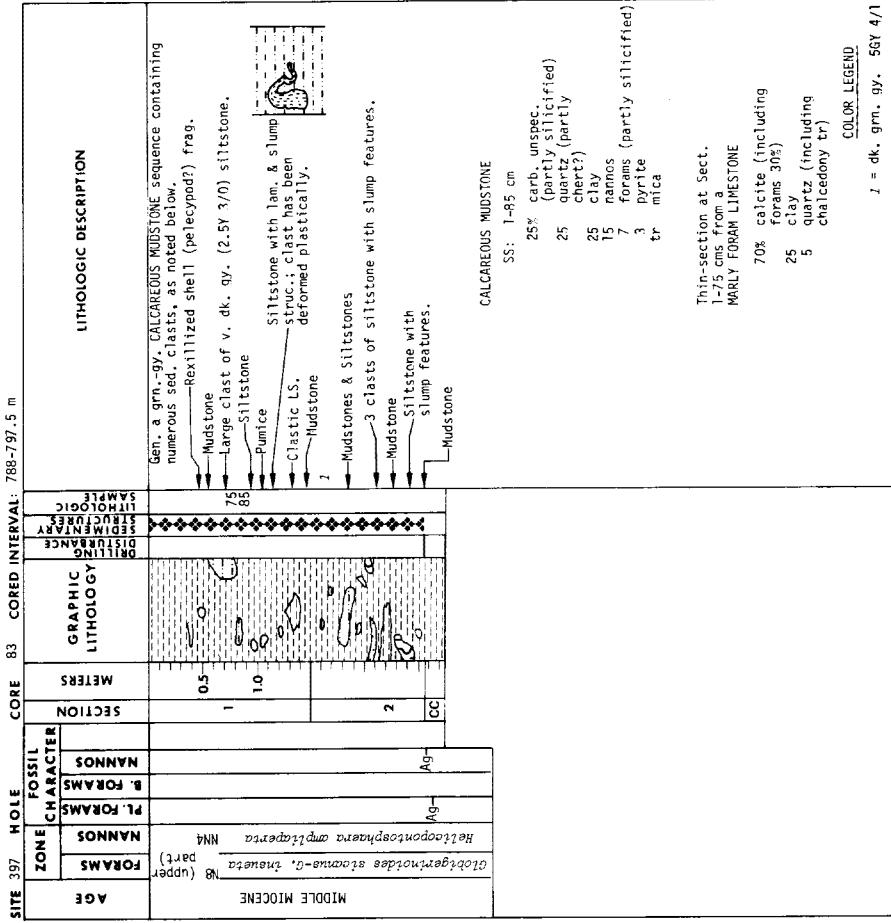
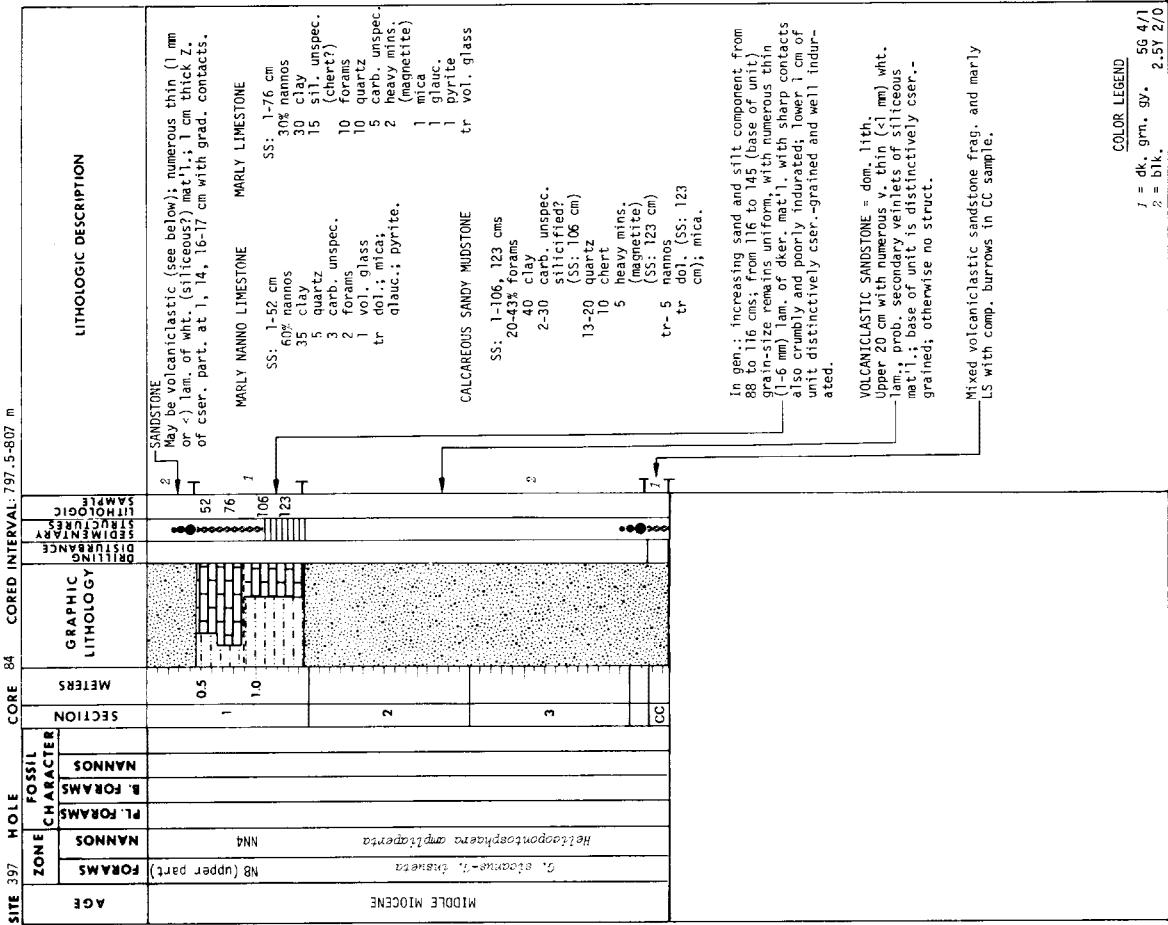
Probability pre-CAMBRIAN AGE

0.5

1

1.0

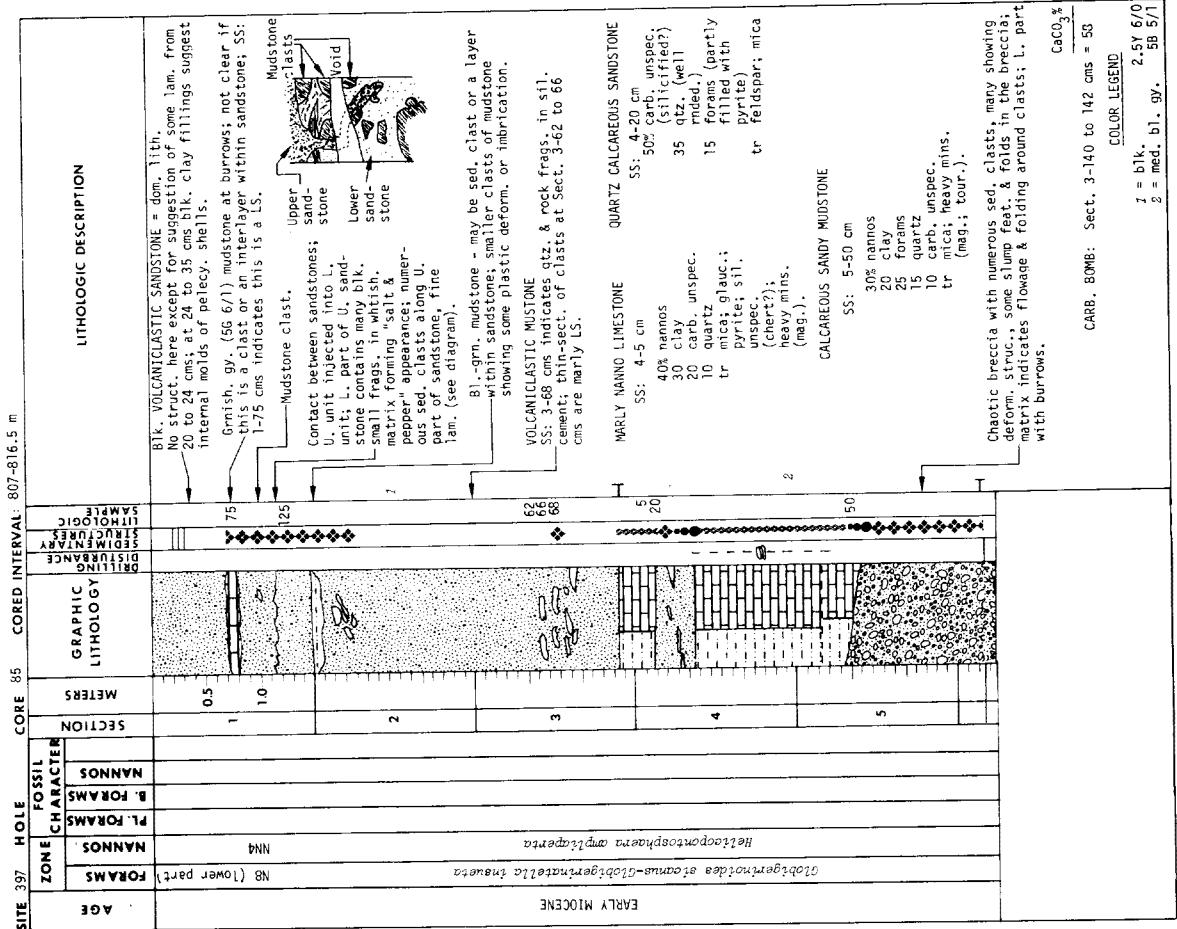
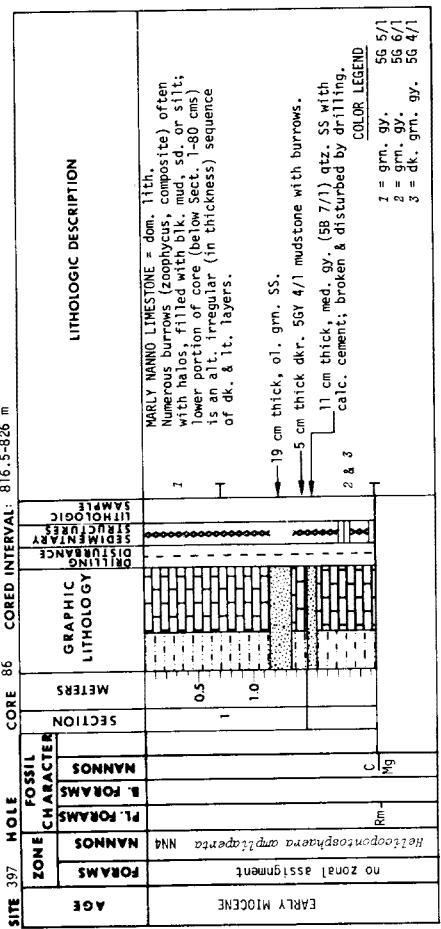
2.5Y 4/0  
2 med. bl. gy.  
3 v. dk. grn. brn. 2.5Y 3/2

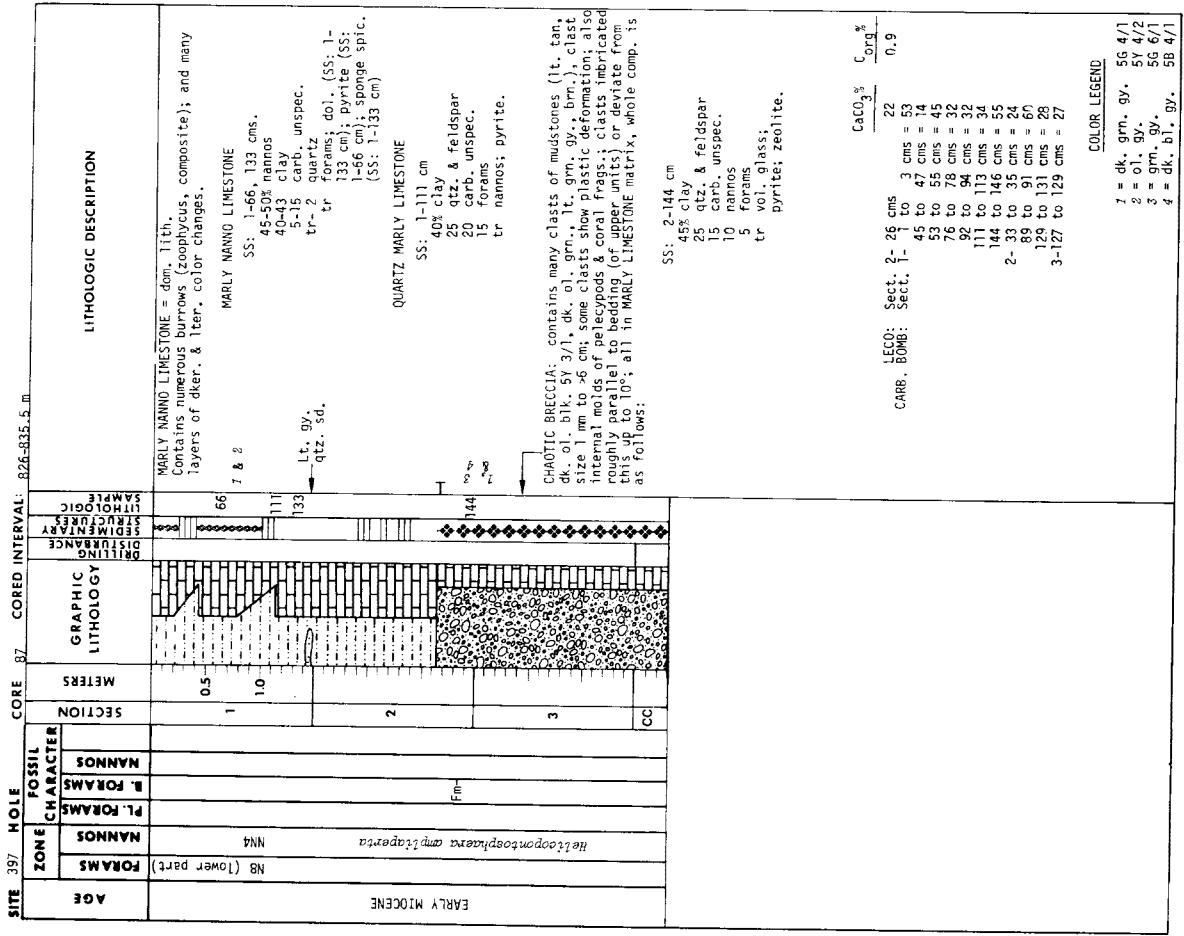
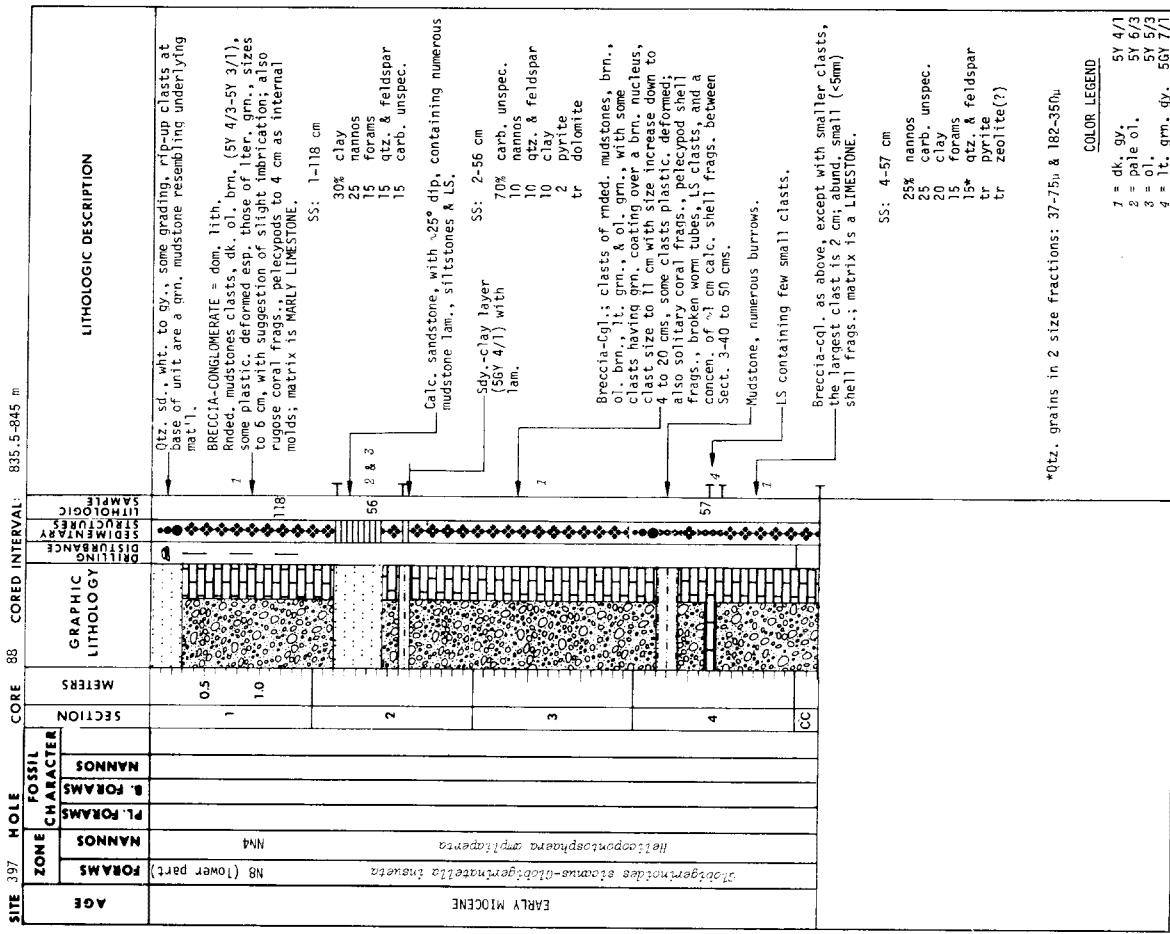


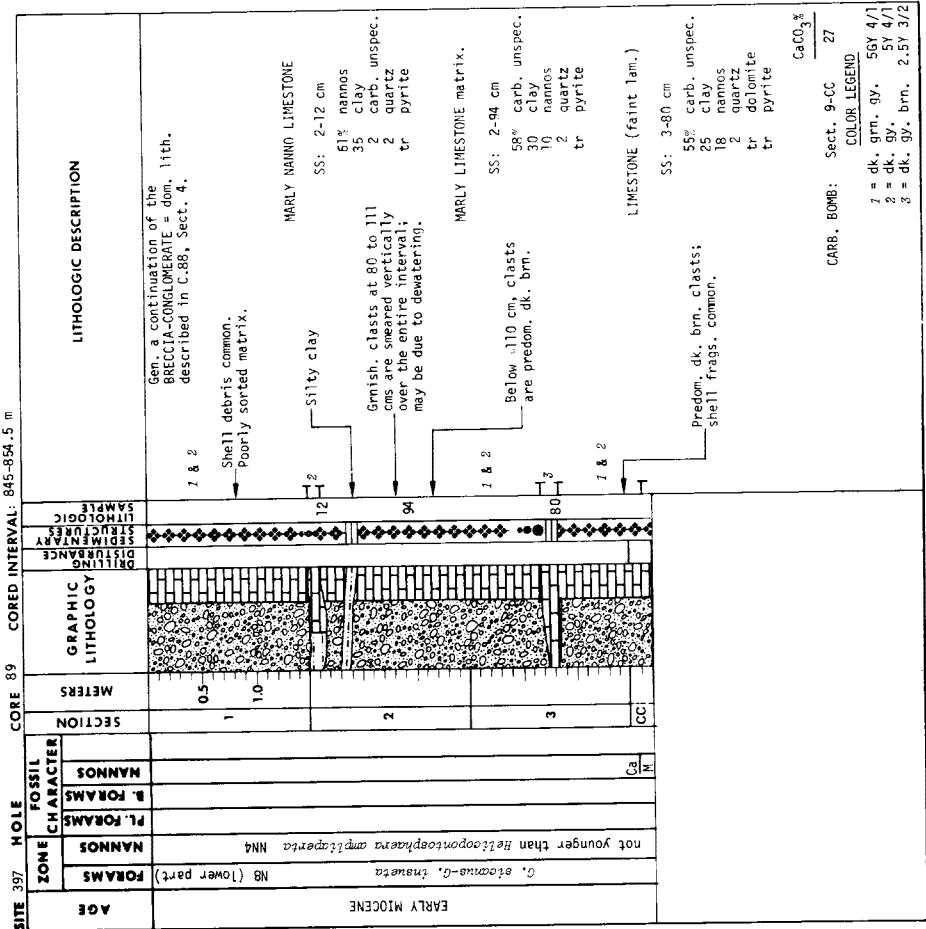
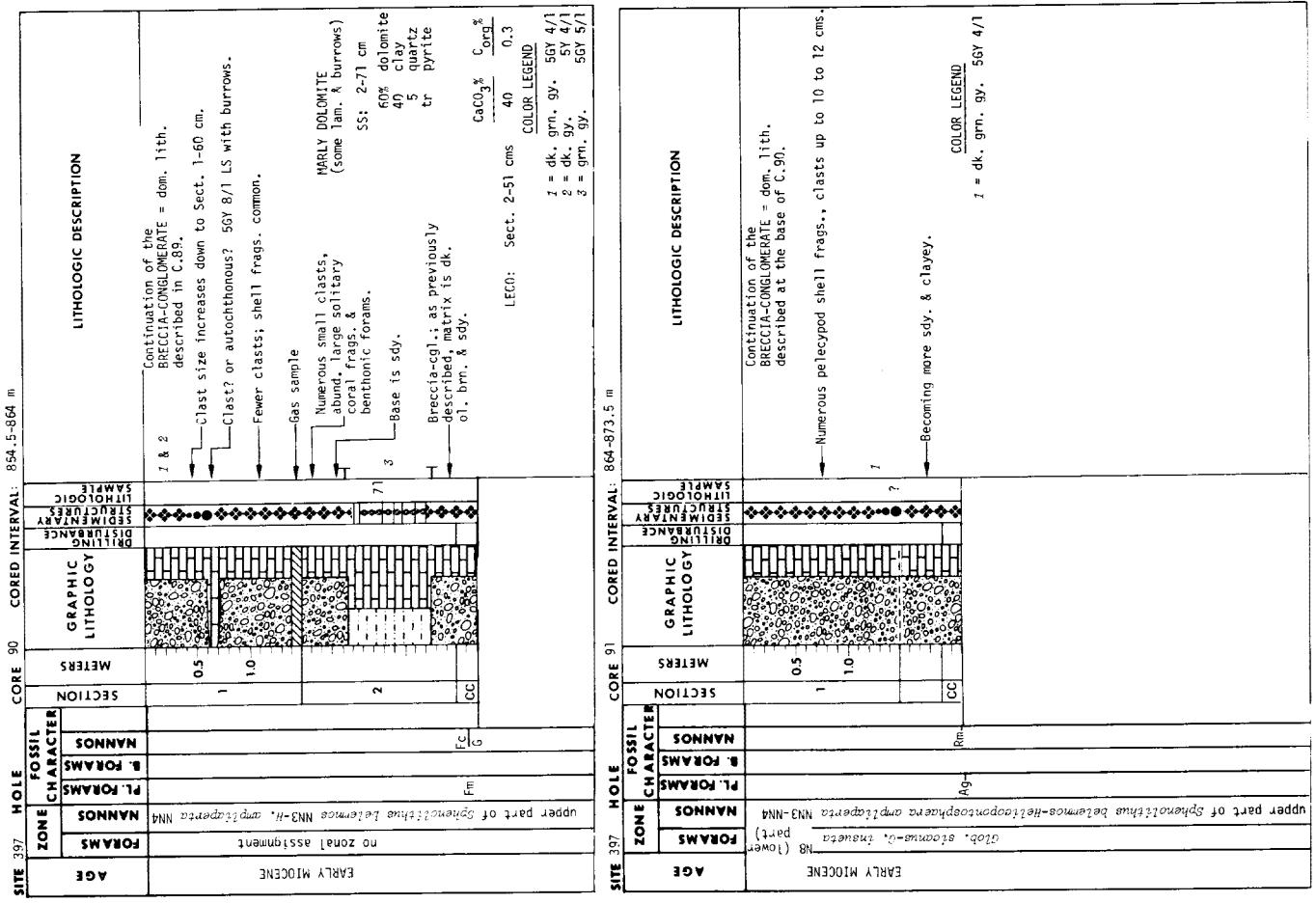
COLOR LEGEND

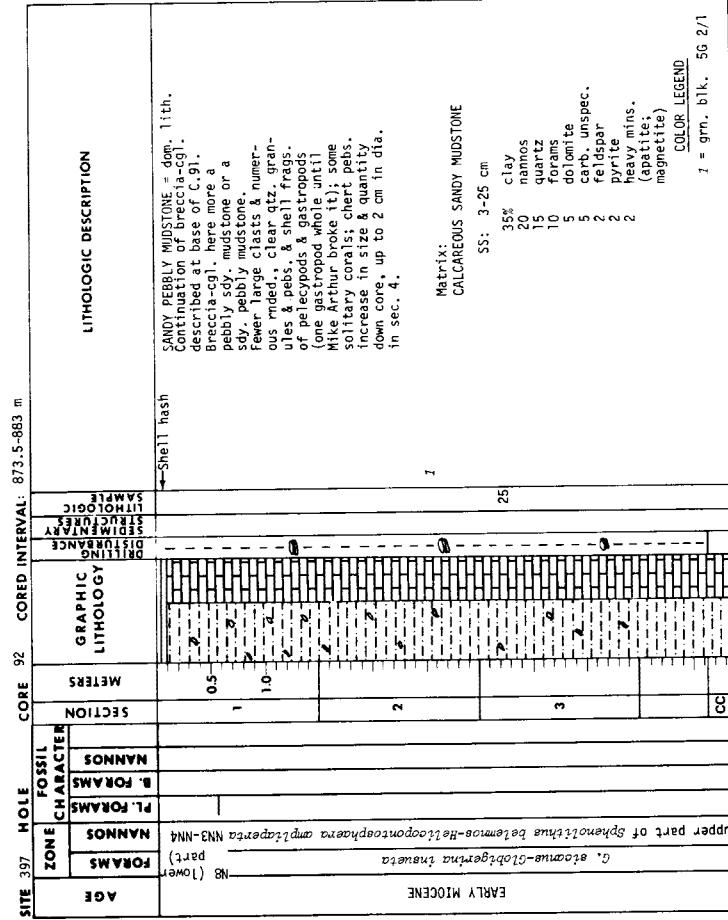
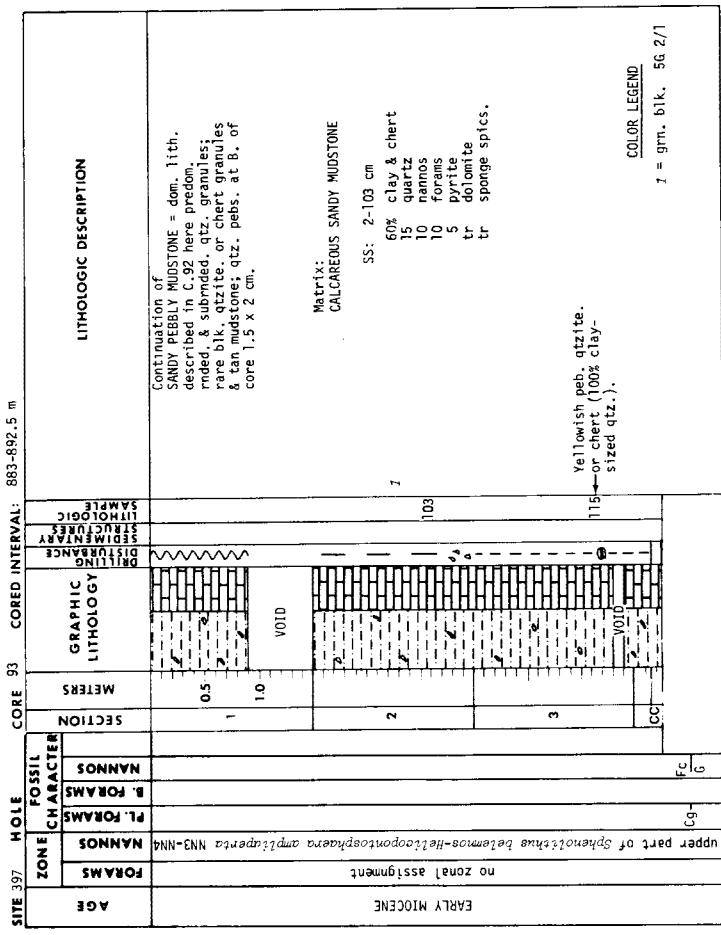
*j* = dk. grn. gy. SG 4/1

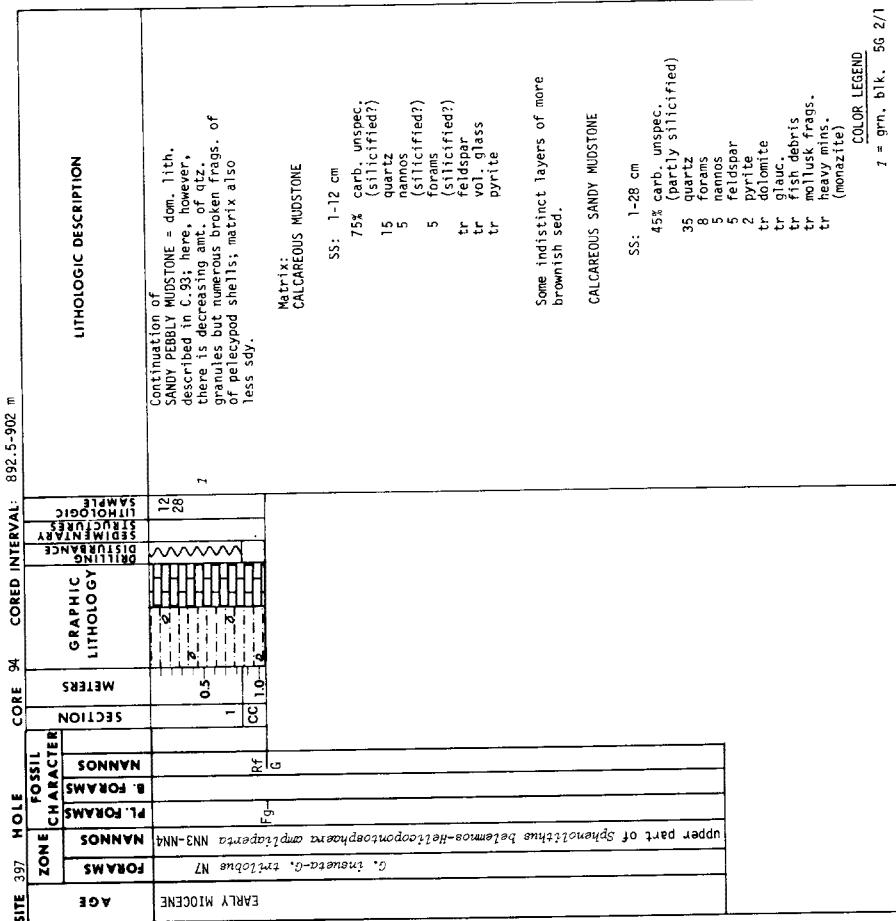
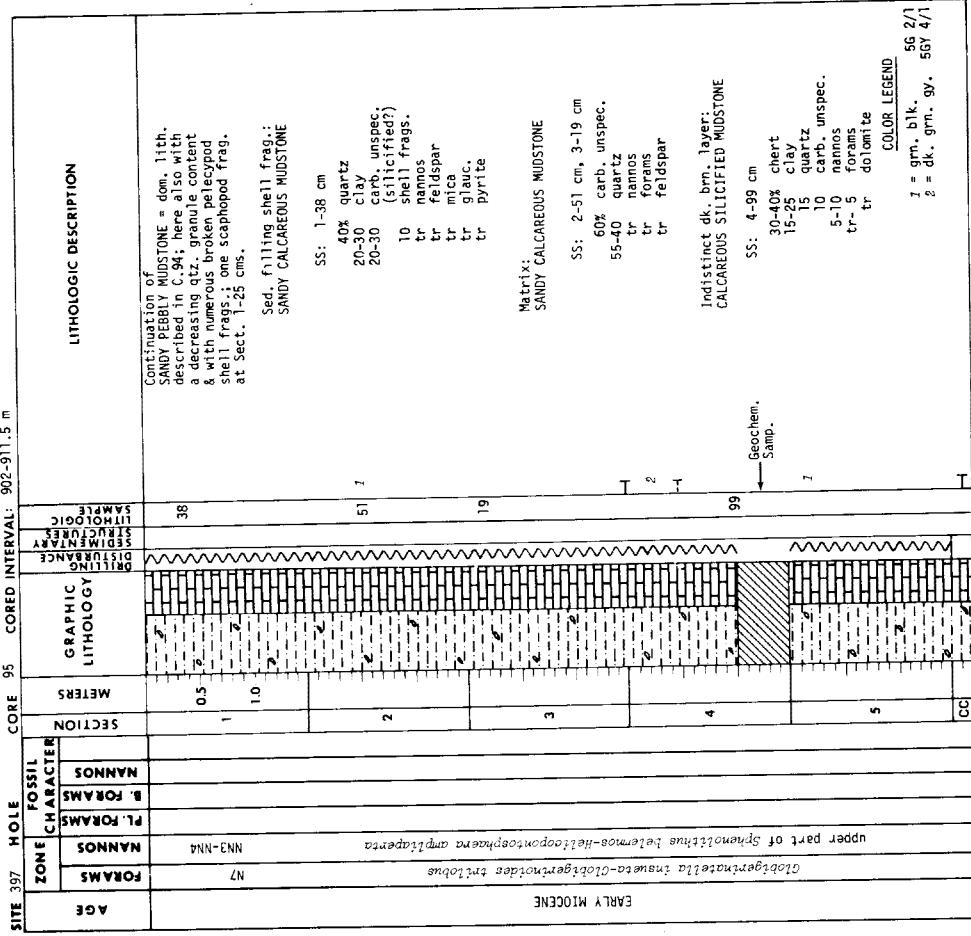
*z* = blk. grn. sp. SG 2/1









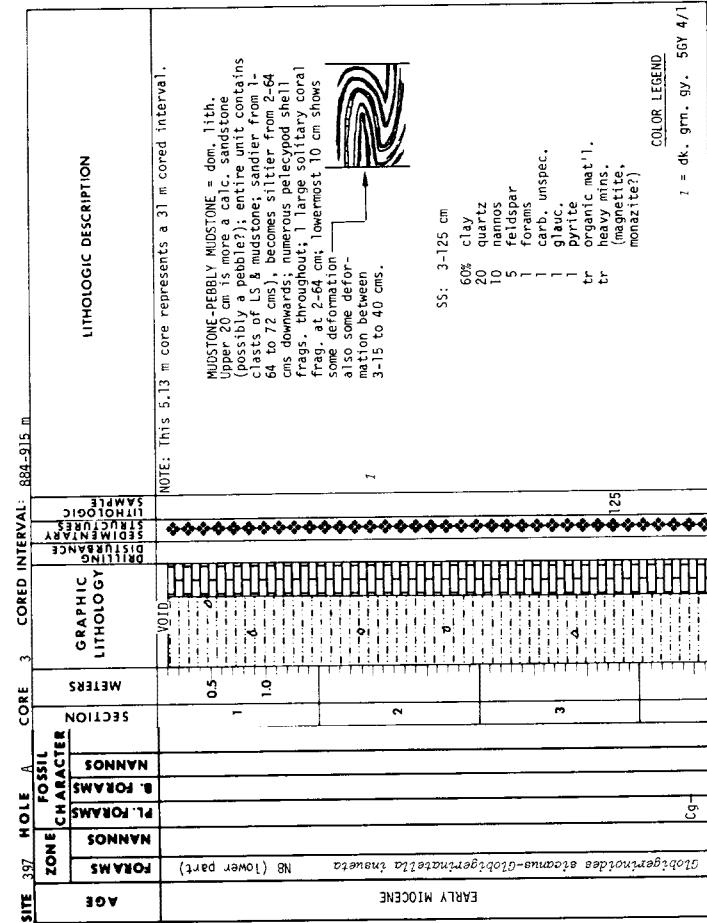
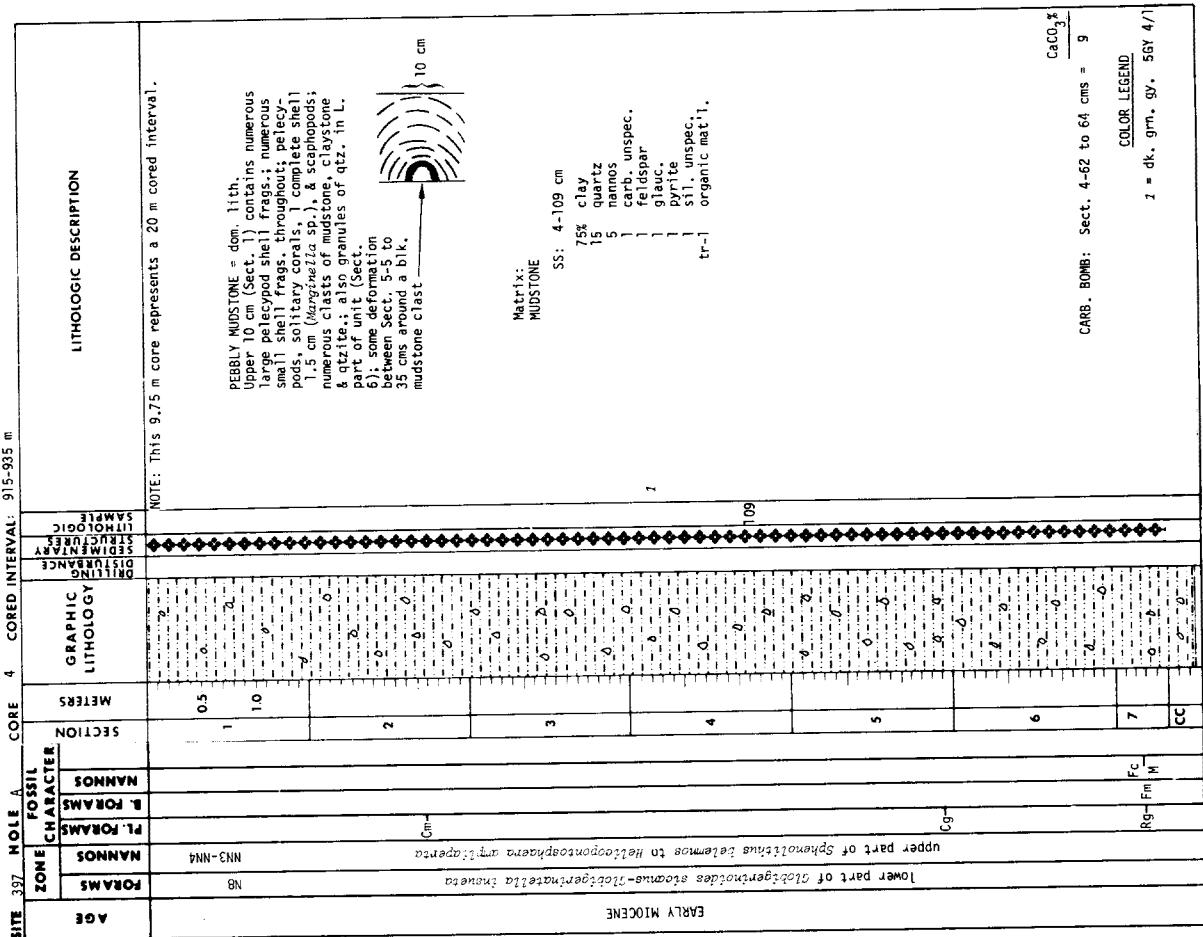


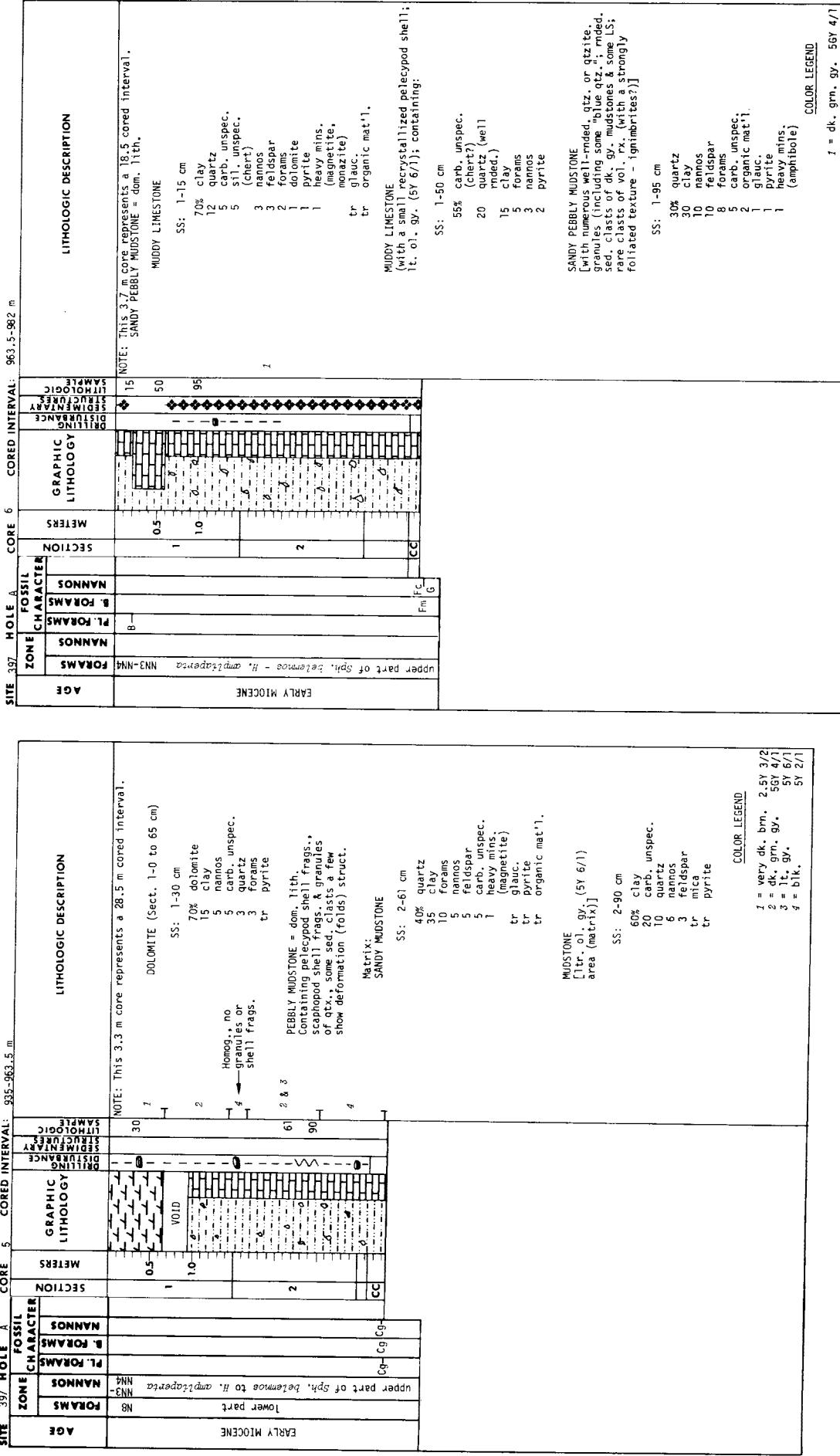
SITE 397	MOLE	CORE	CORED INTERVAL: 921-930.5 m	LITHOLOGIC DESCRIPTION		SAMPLE LITHOTOGIC STRUCTURES SINTEREDNESS DILUTION	Site 397, Core 98, 930.5-940 m; NO CORE RECOVERED Site 397, Core 99, 940-949.5 m; NO CORE RECOVERED Site 397, Core 100, 949.5-959 m; NO CORE RECOVERED
				AGE	ZONE CHARACTER	METERS	
				EARLY MIocene		0.5	
				no zonal assemblage	FORMATS PL. FORMAS B. FORMAS NANOS	1	
				upper part of <i>Sphaerolithus</i> elements- <i>A</i> , <i>opitispaperata</i> NNN-NNN	NANOS		Fg-
							C-1
F9-							

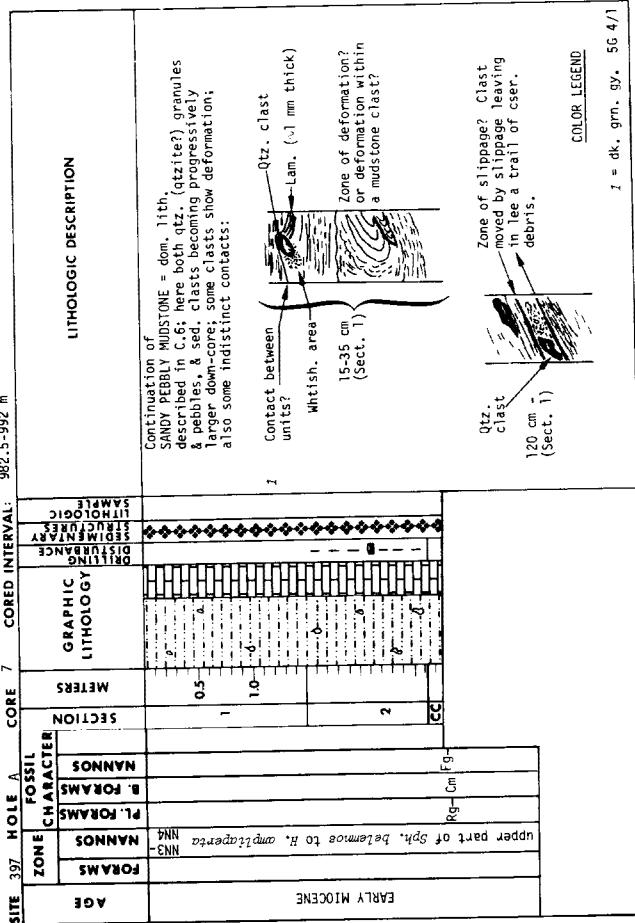
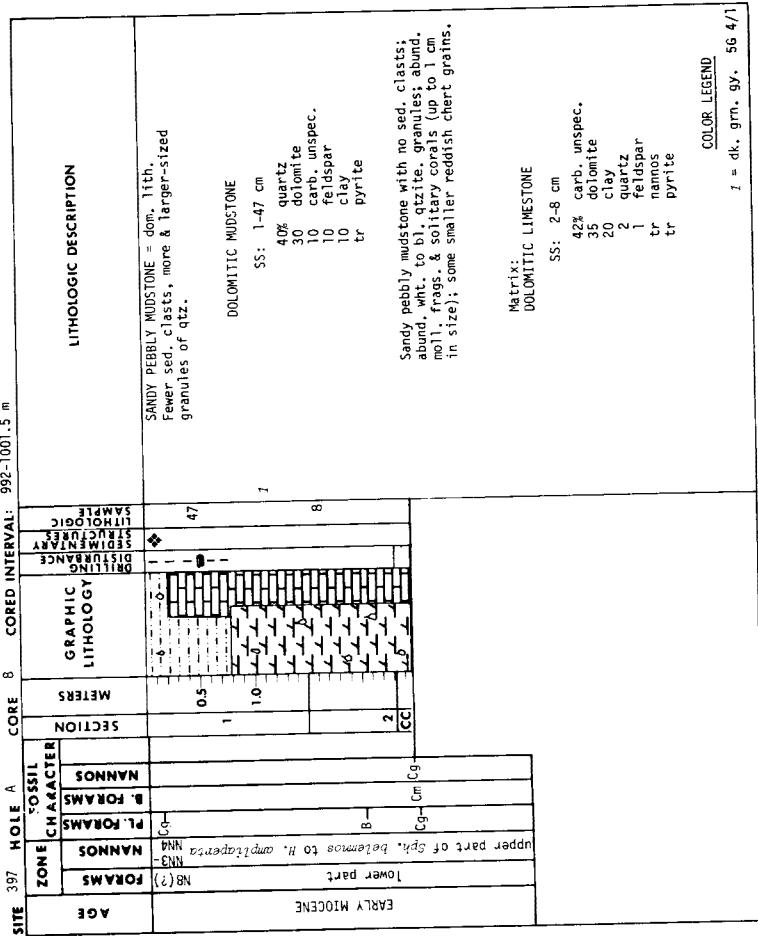
SITE 397		HOLE 96		CORE INTERVAL: 911.5-921 m		LITHOLOGIC DESCRIPTION	
AGE	EARLY MIOCENE	ZONE CHARACTER	FOSSIL CHARACTER	SECTION METERS	GRAPHIC LITHOLOGY	DISCUSSION	SAMPLE NUMBER
FORMATS	NANNO	FORMATS	NANNO	FORMATS	NANNO	FORMATS	NANNO
6. <i>Inusitata</i> -Globigerinoides trilobatum	N7	6. <i>Inusitata</i> -Globigerinoides trilobatum	N7	0.5	2	Continuation of SANDY PEBBLY MUDSTONE = dom. lith. described in C.95.	
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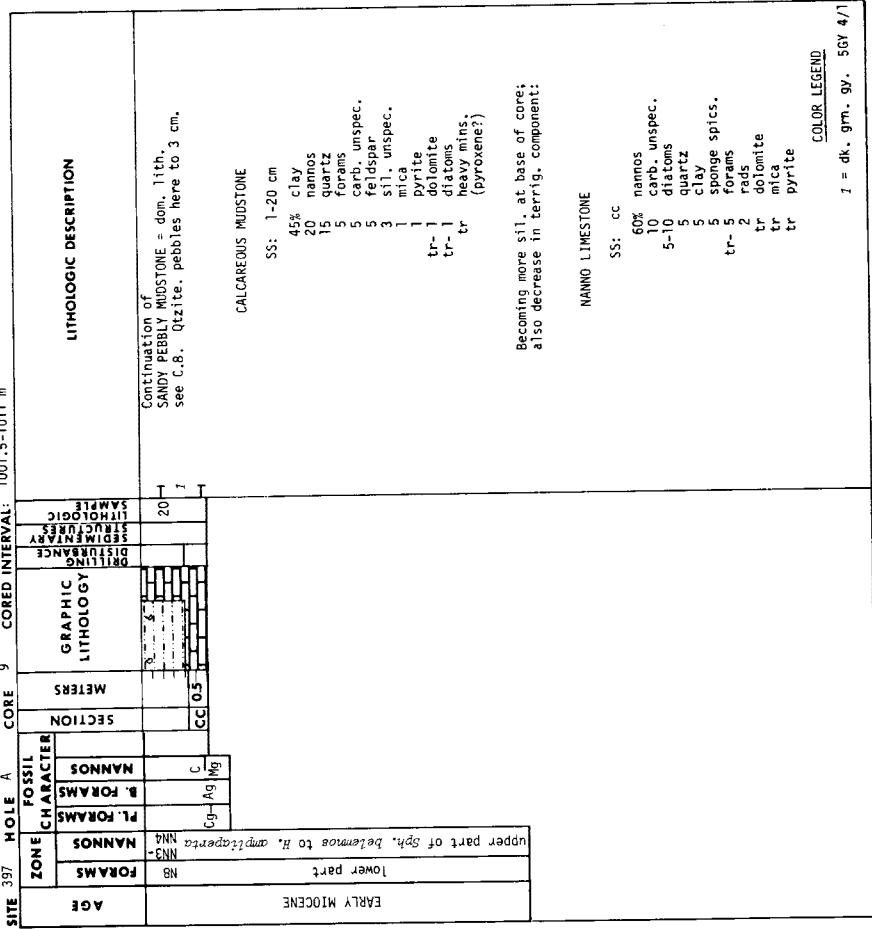
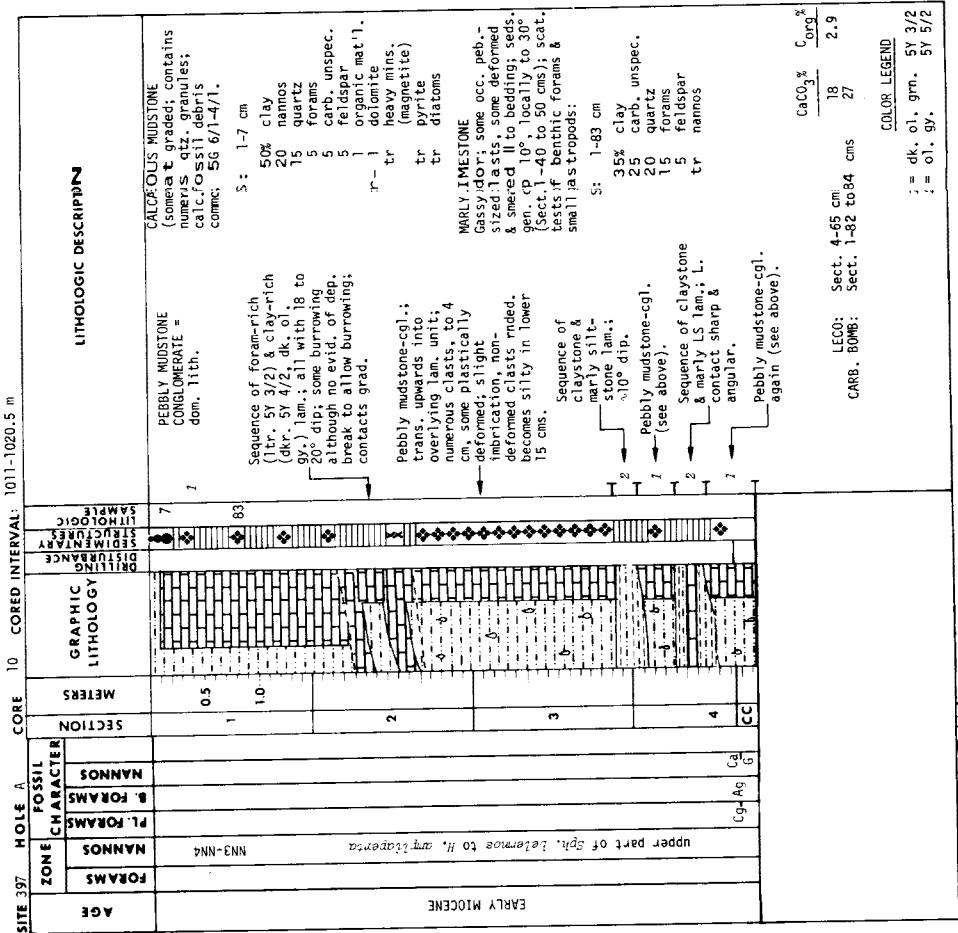


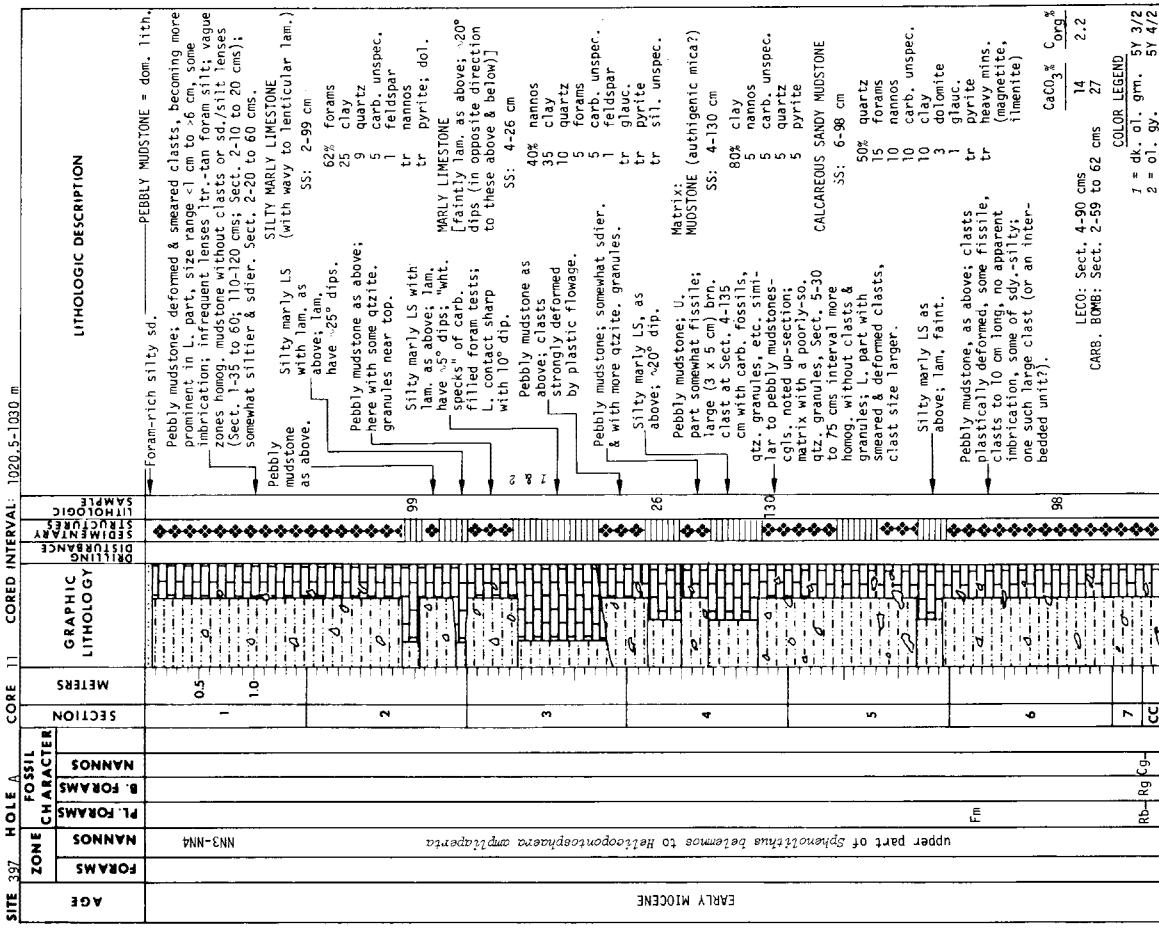
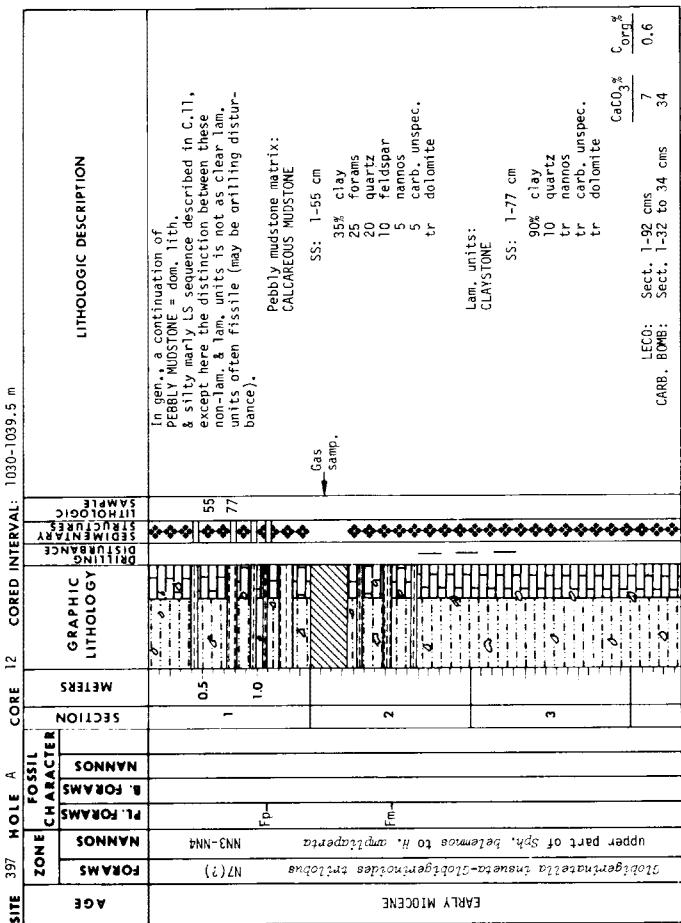


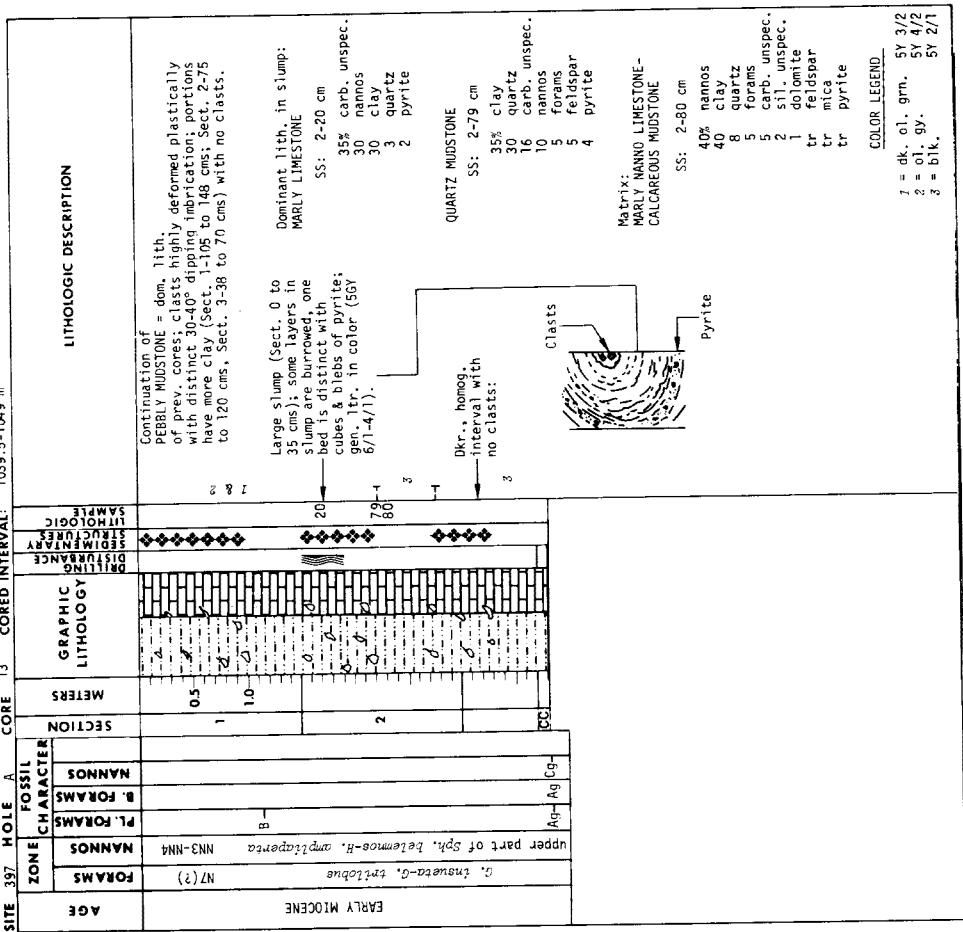
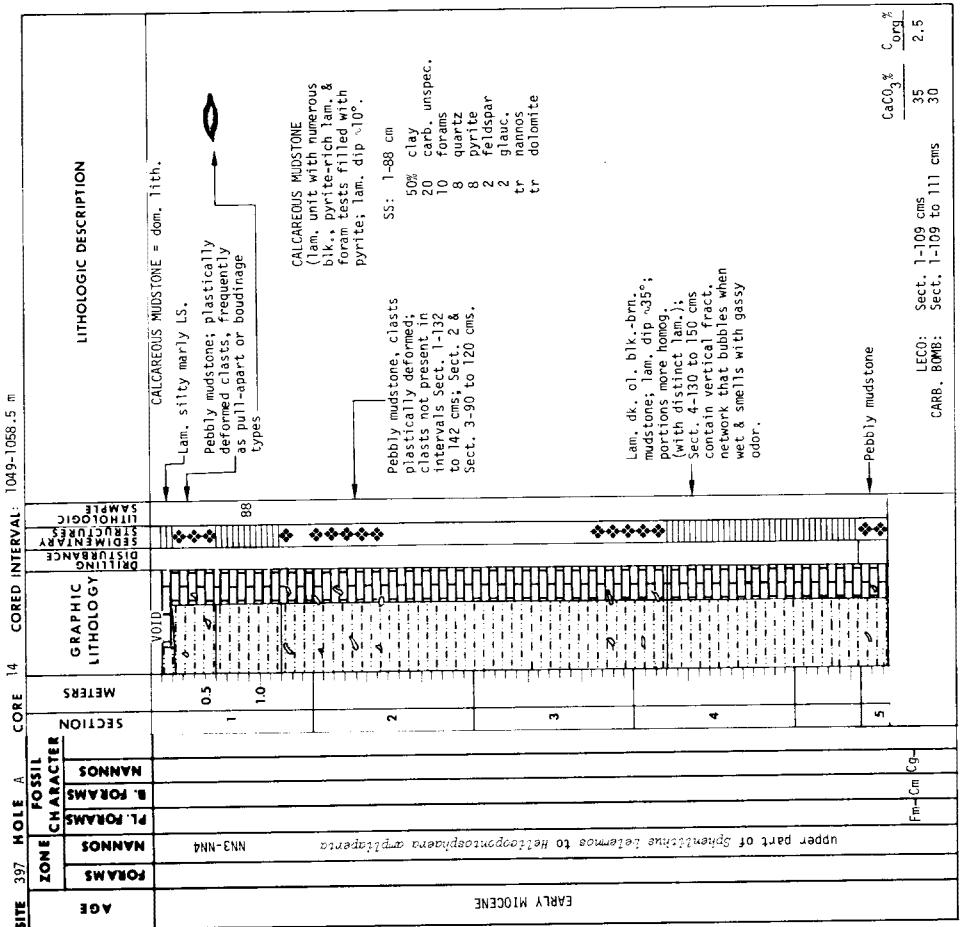


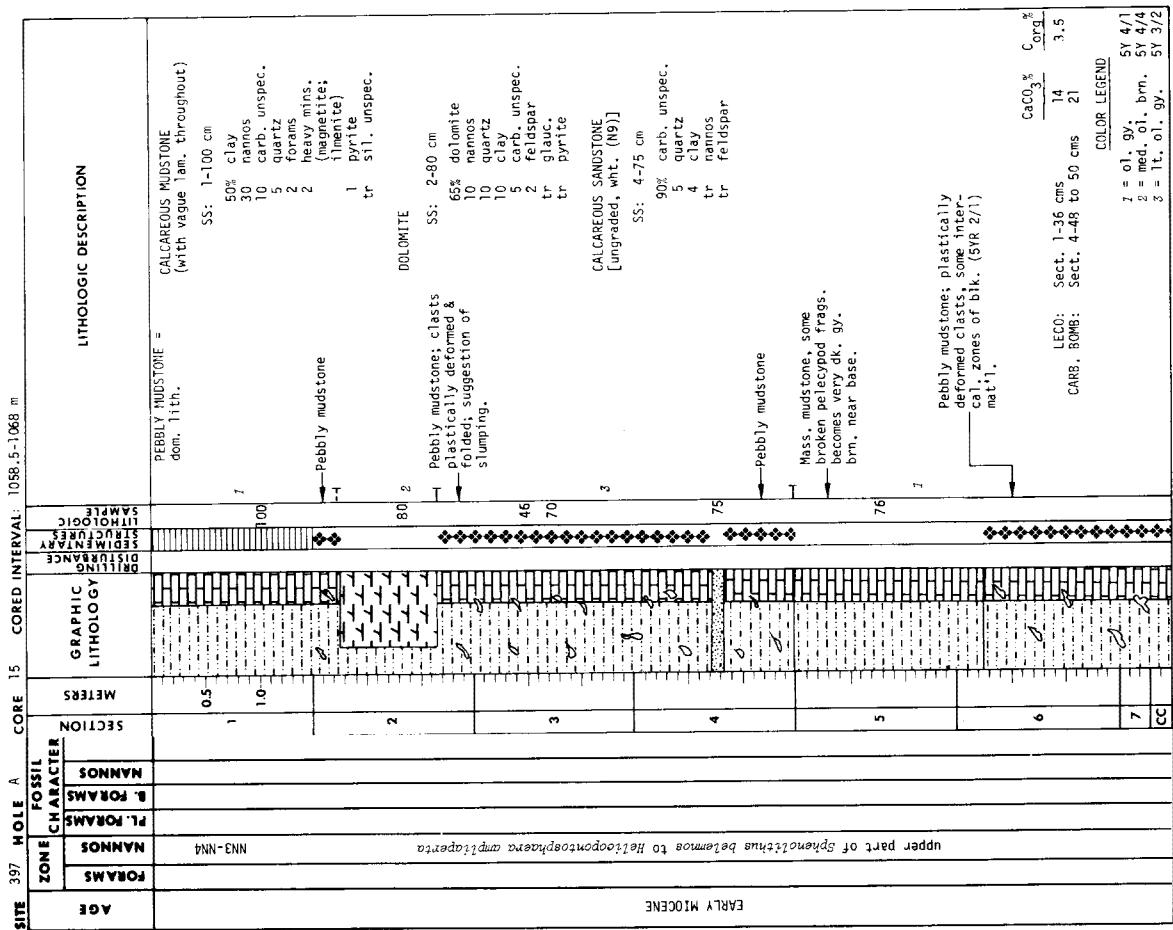
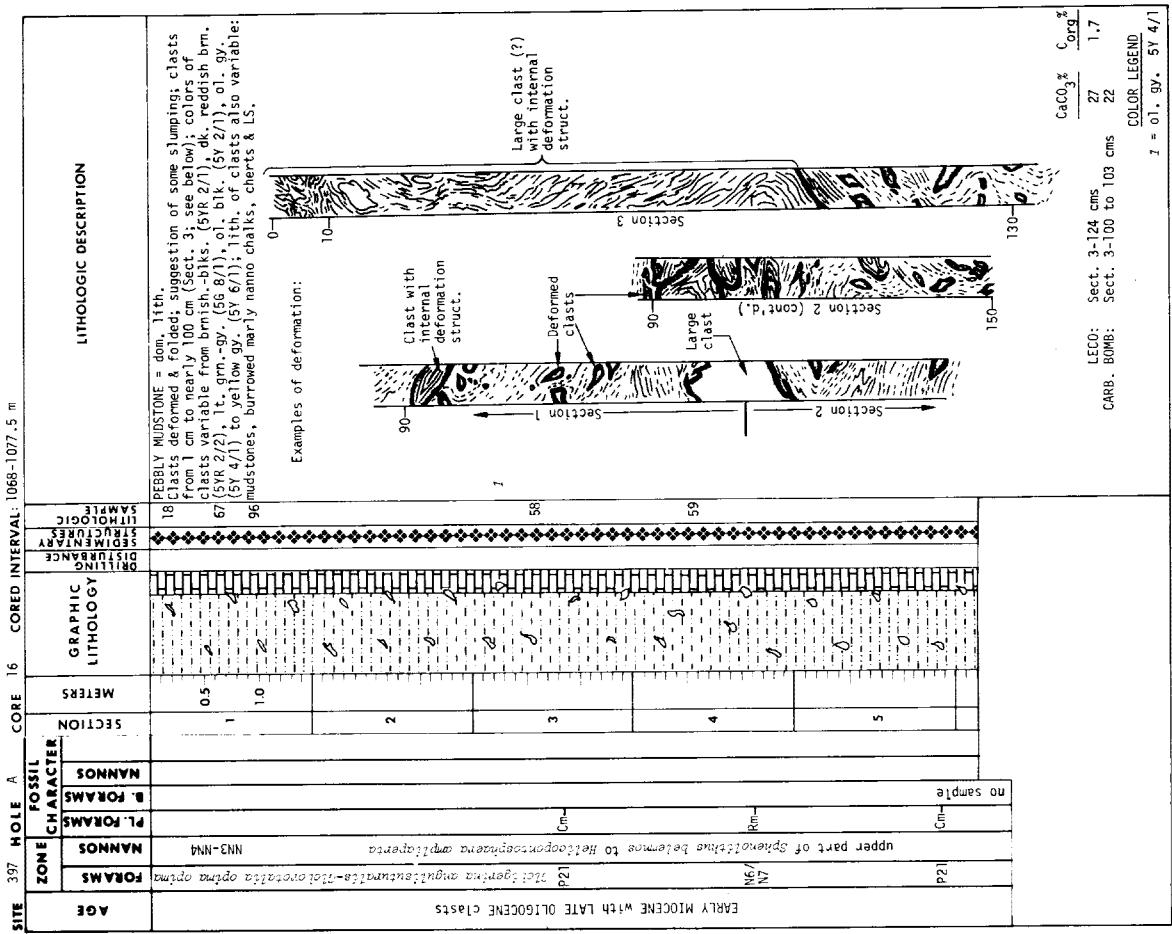


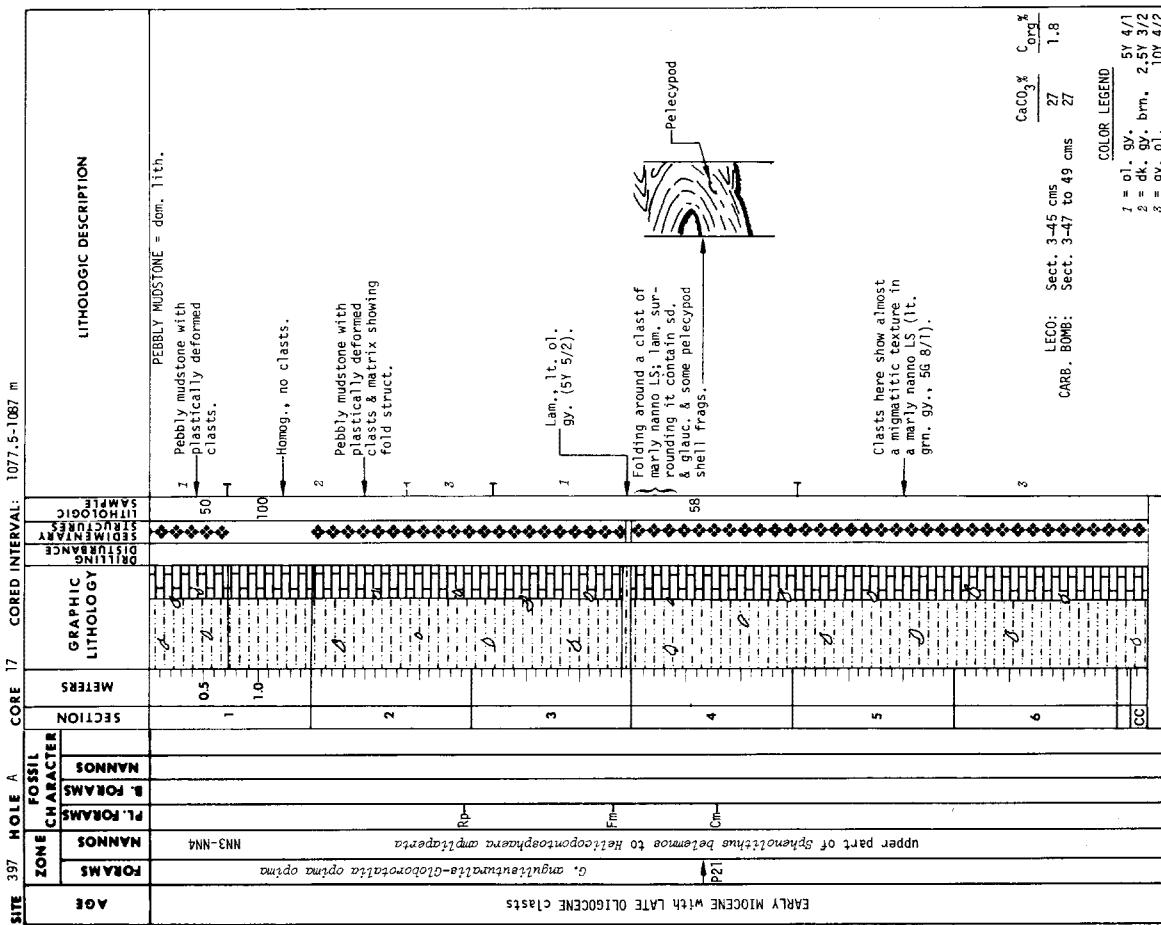
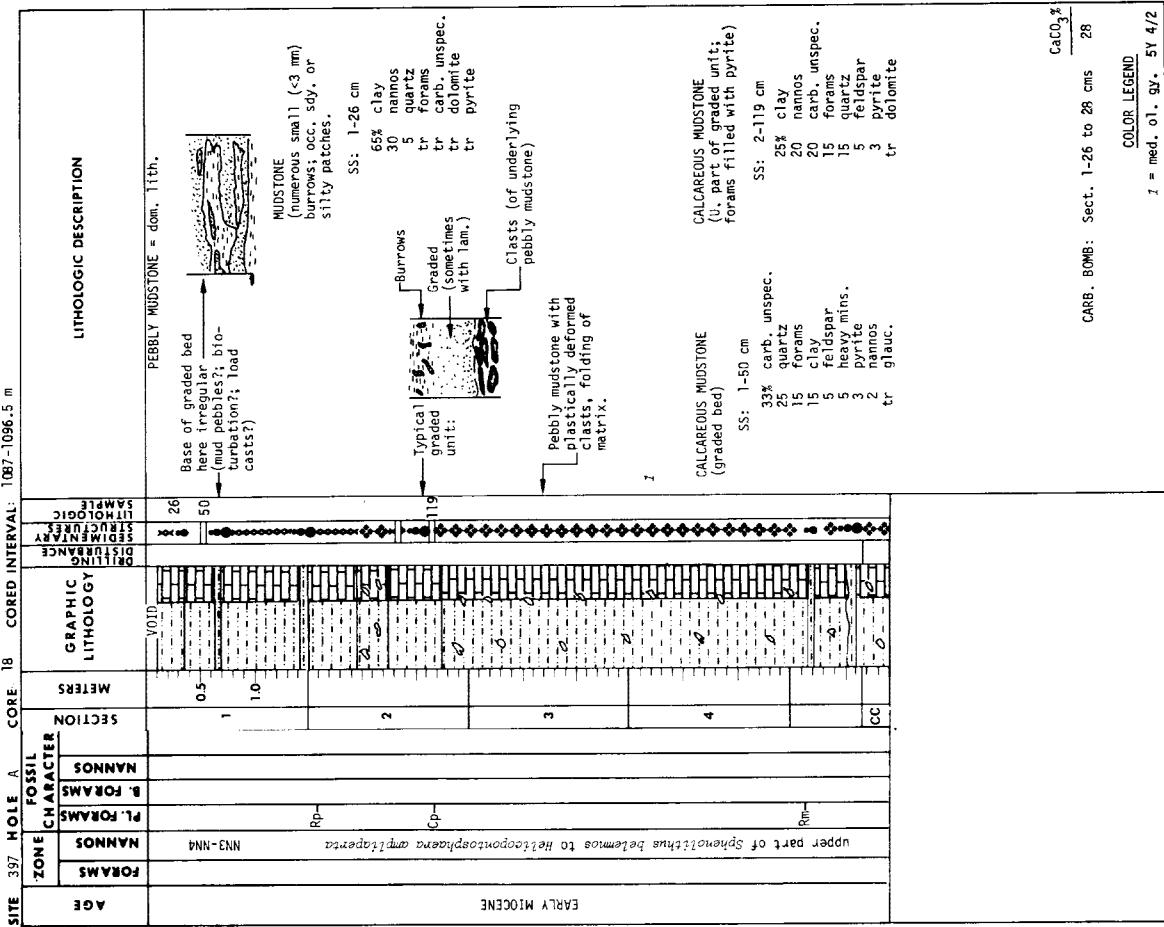


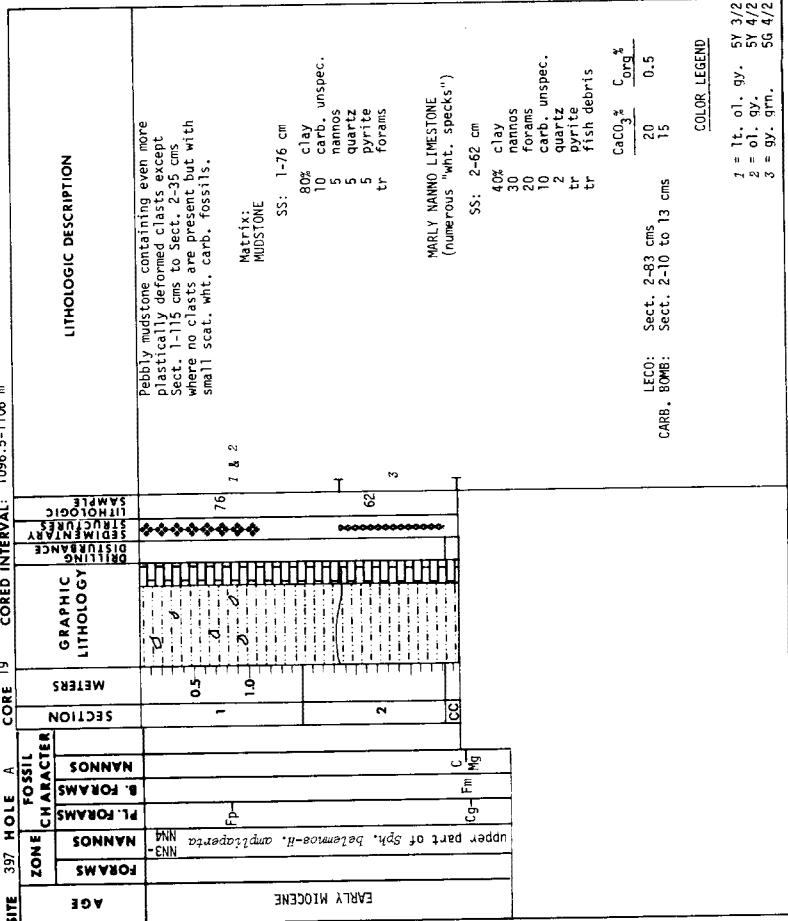
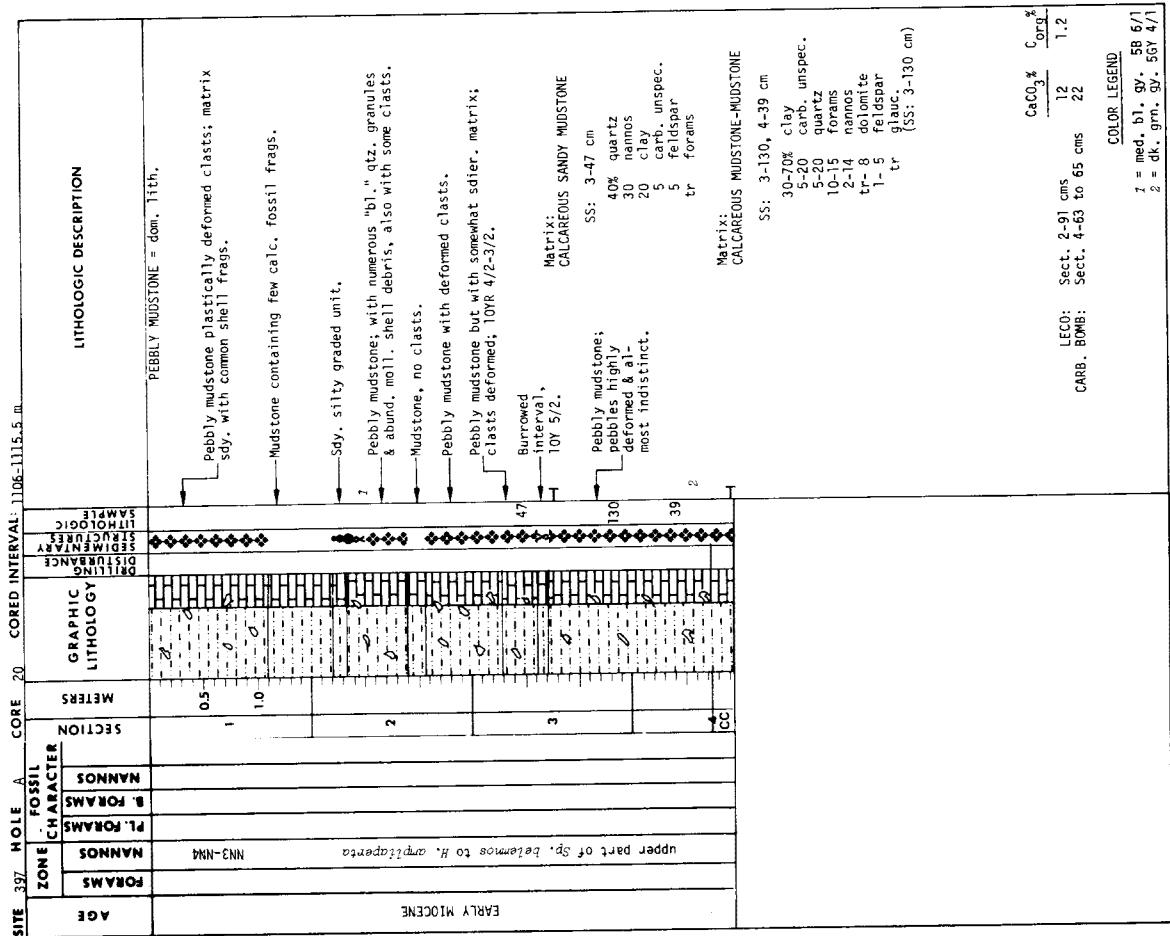








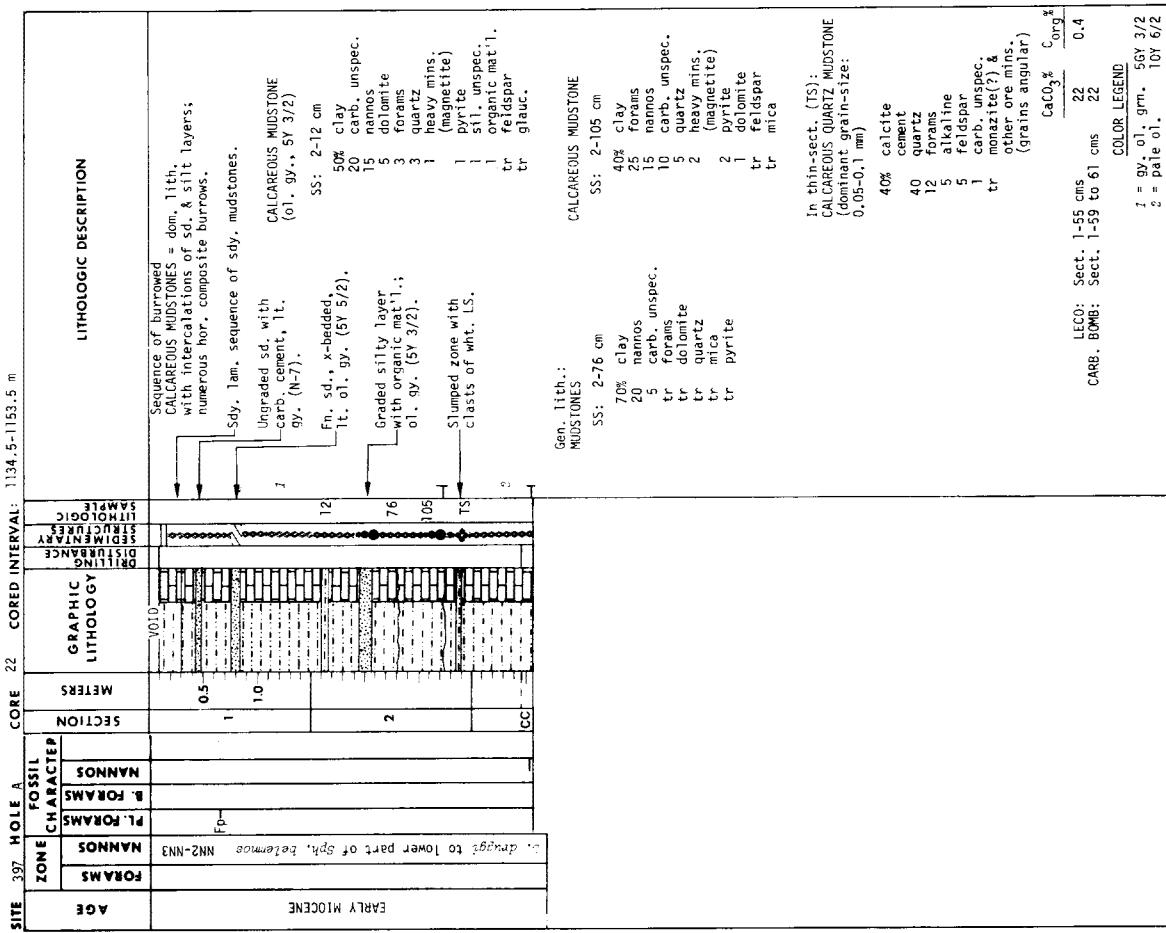


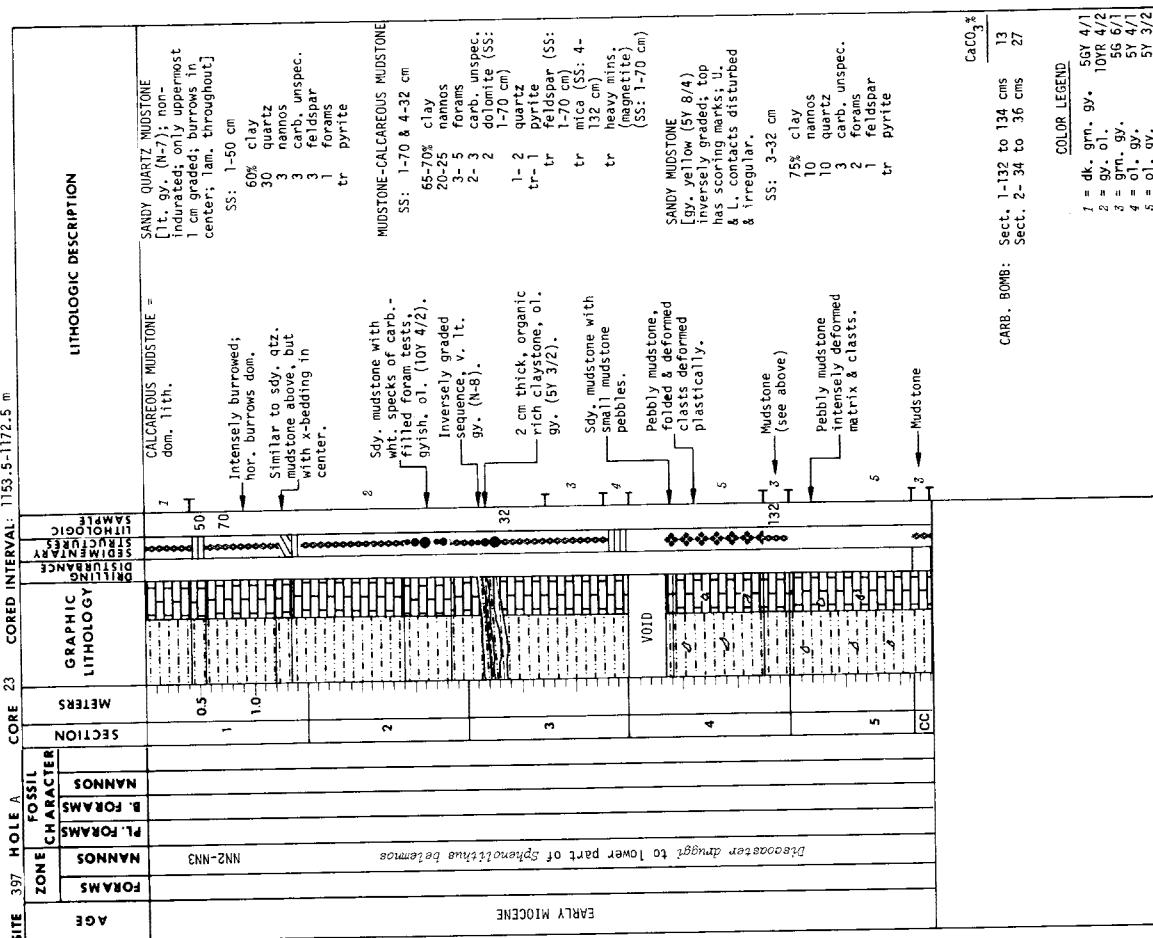
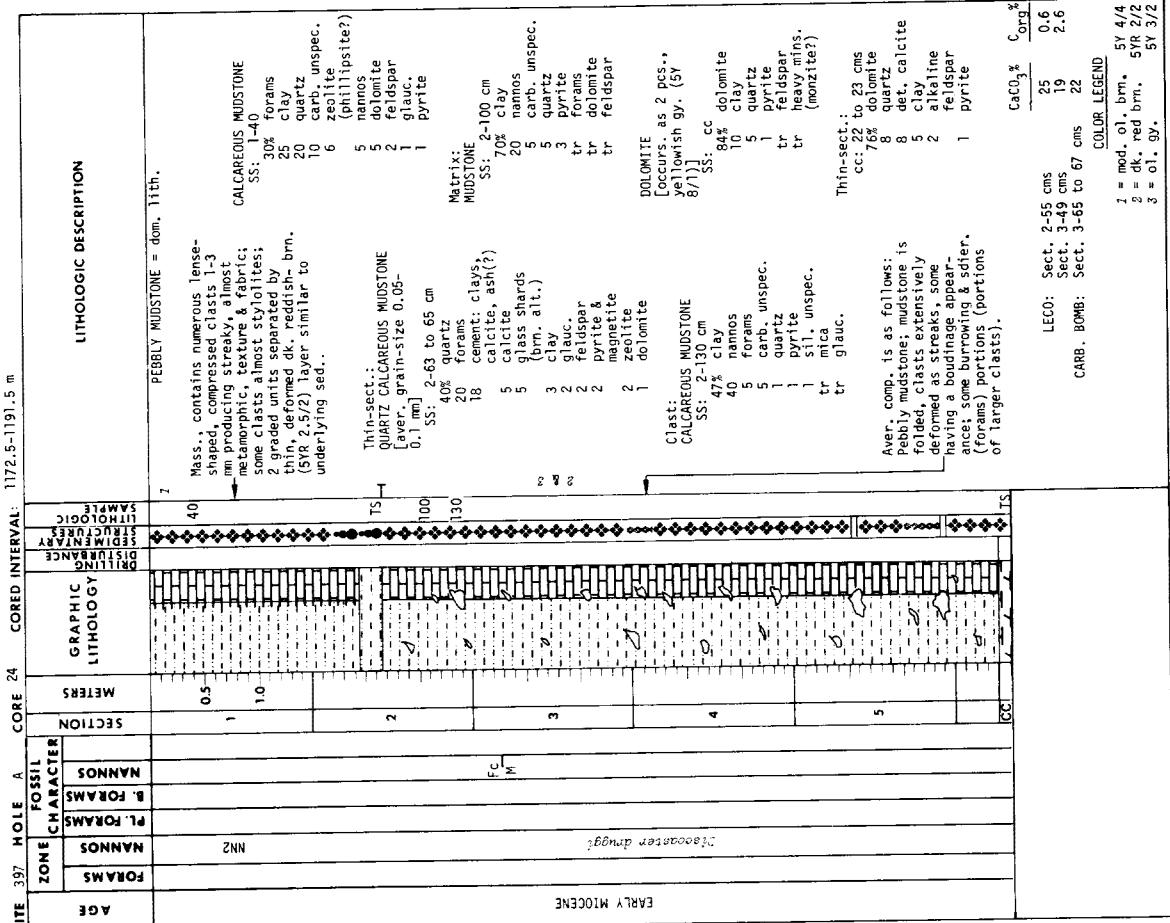


CARB. BOMB:	LECO:	$\frac{\text{CaCO}_3\%}{\text{C}_\text{org}\%}$
Sect. 4-63 to 65 cms	Sect. 2-91 cms	12 1.2
22	22	

COLOR LEGEND

1 = med. bl. gr. 5G 5/1  
2 = dk. grn. 5G 4/1

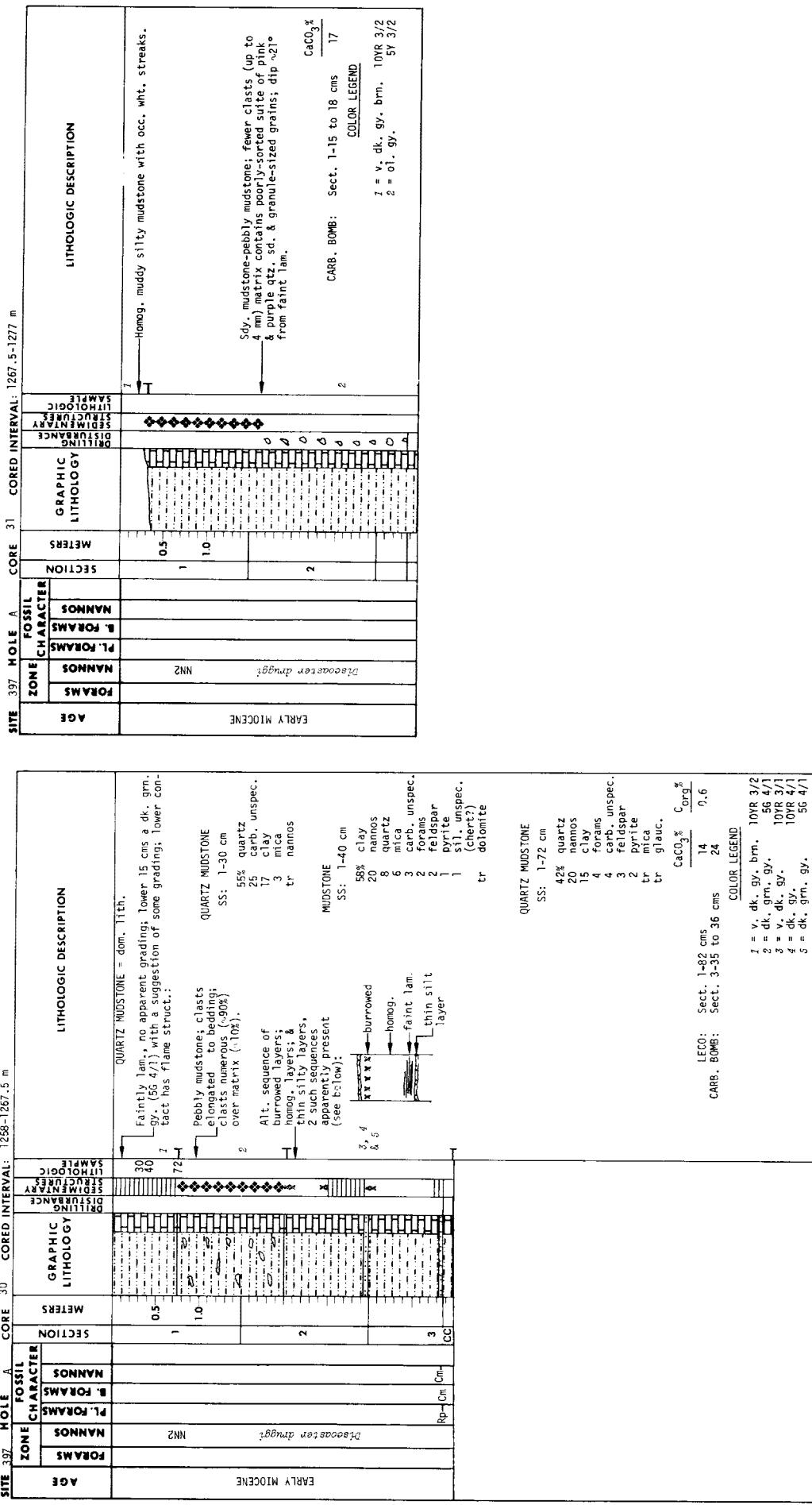


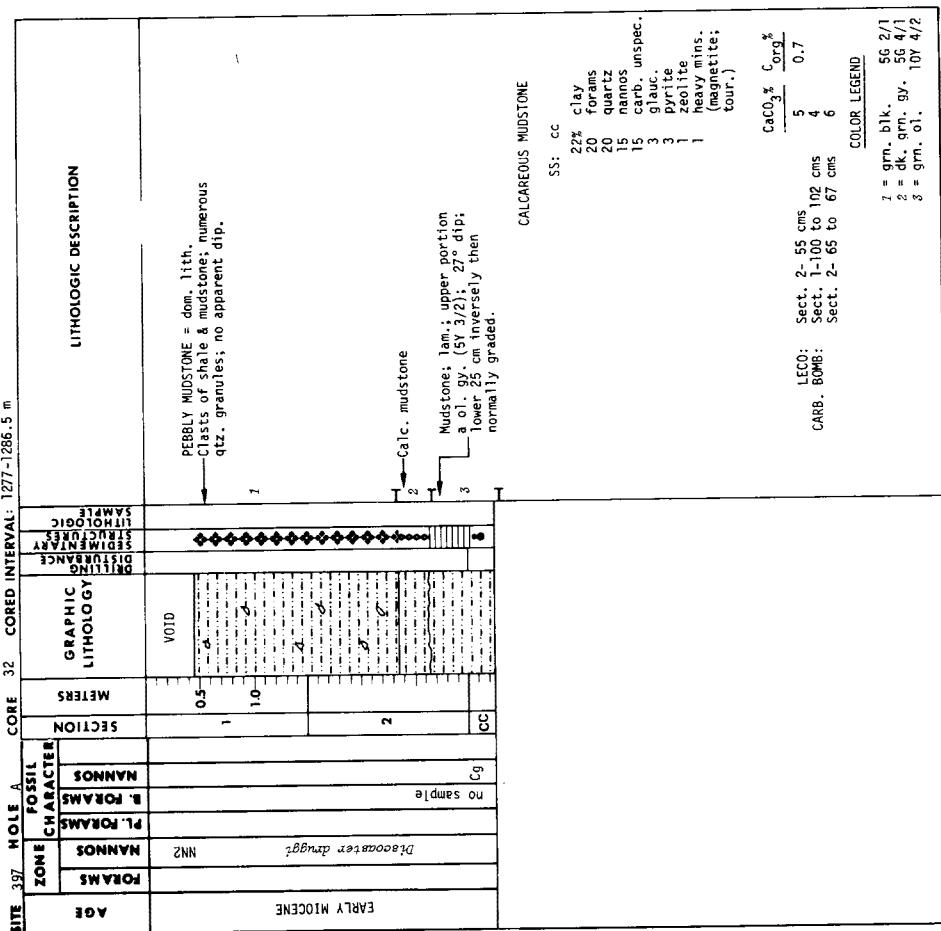
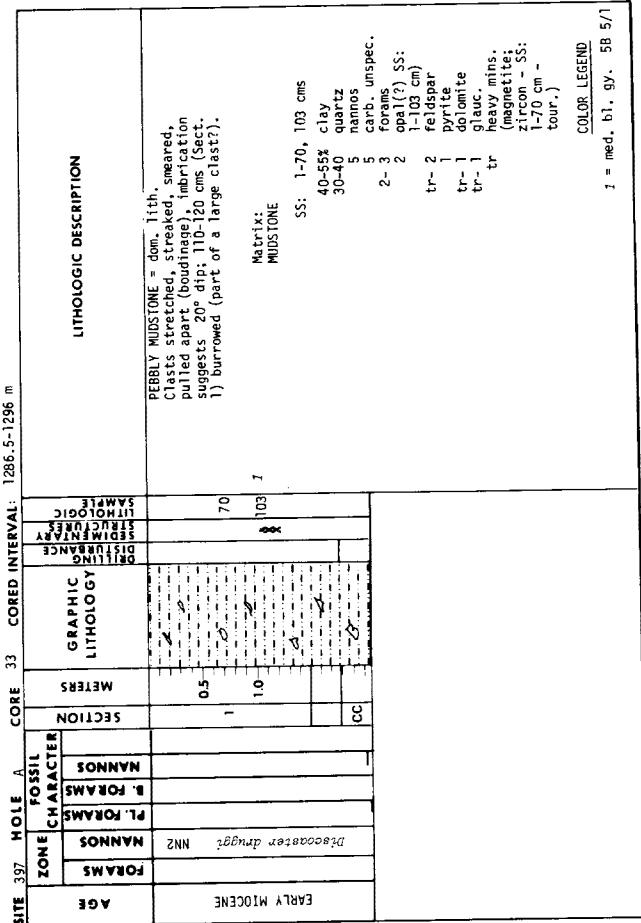


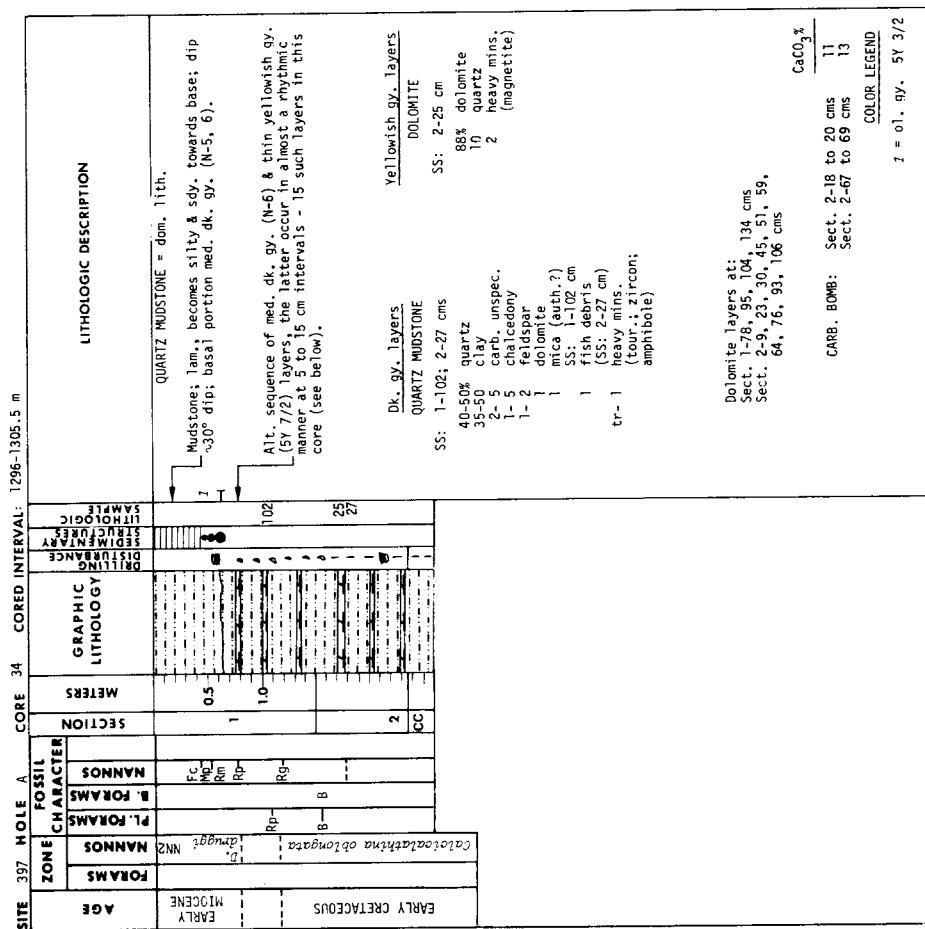
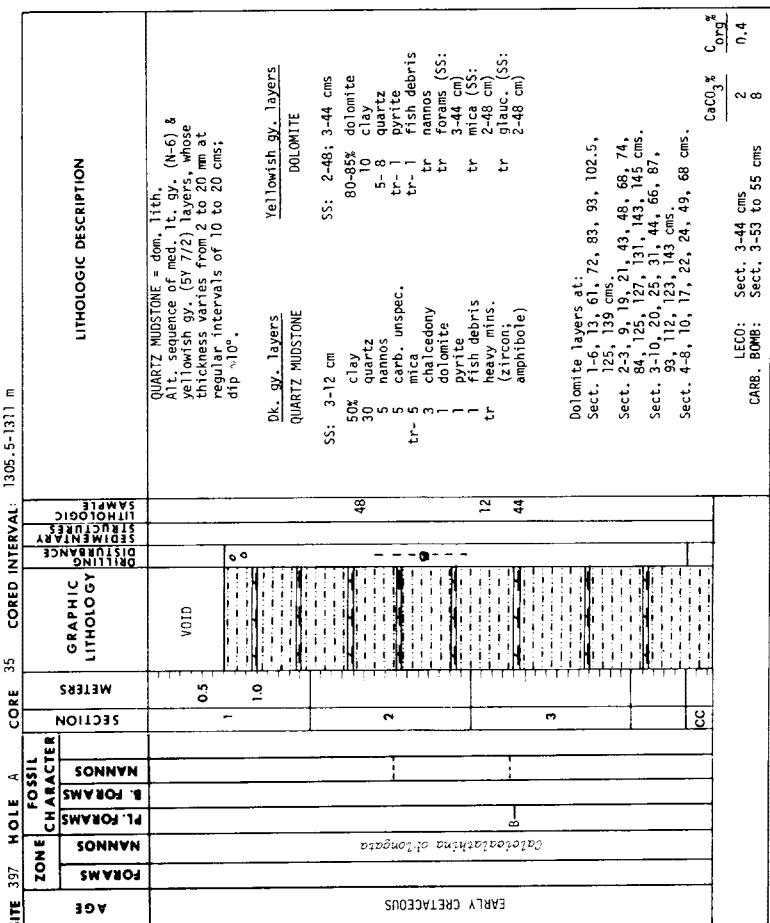
EARLY Miocene

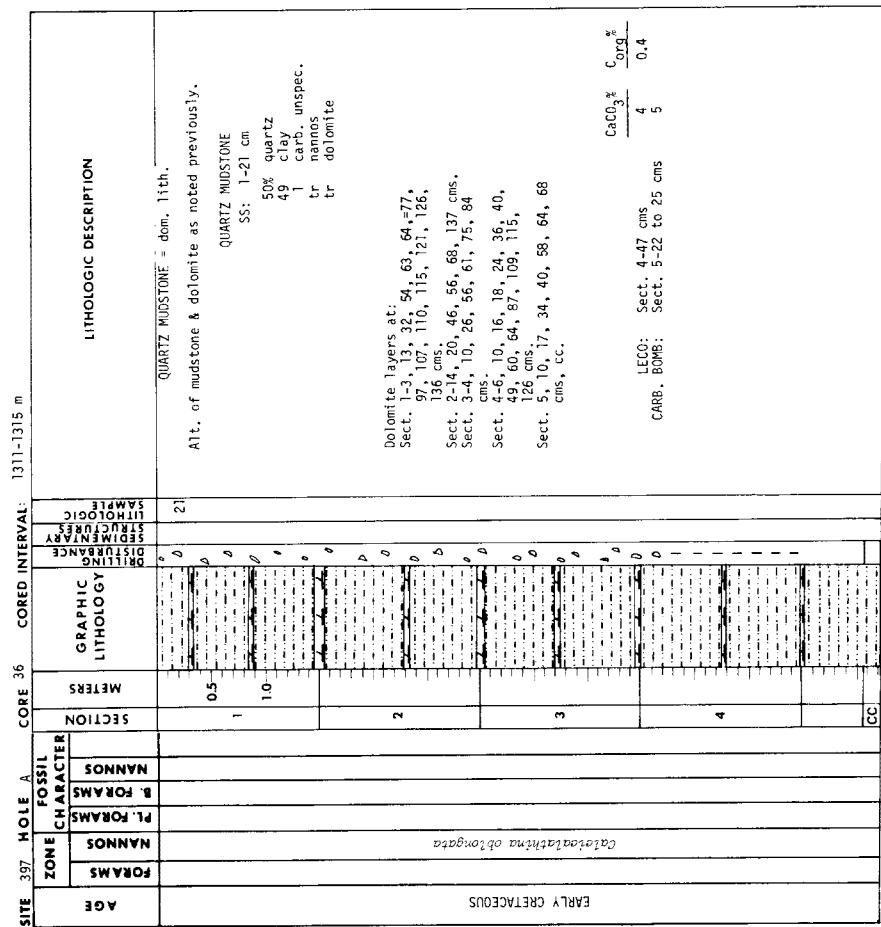
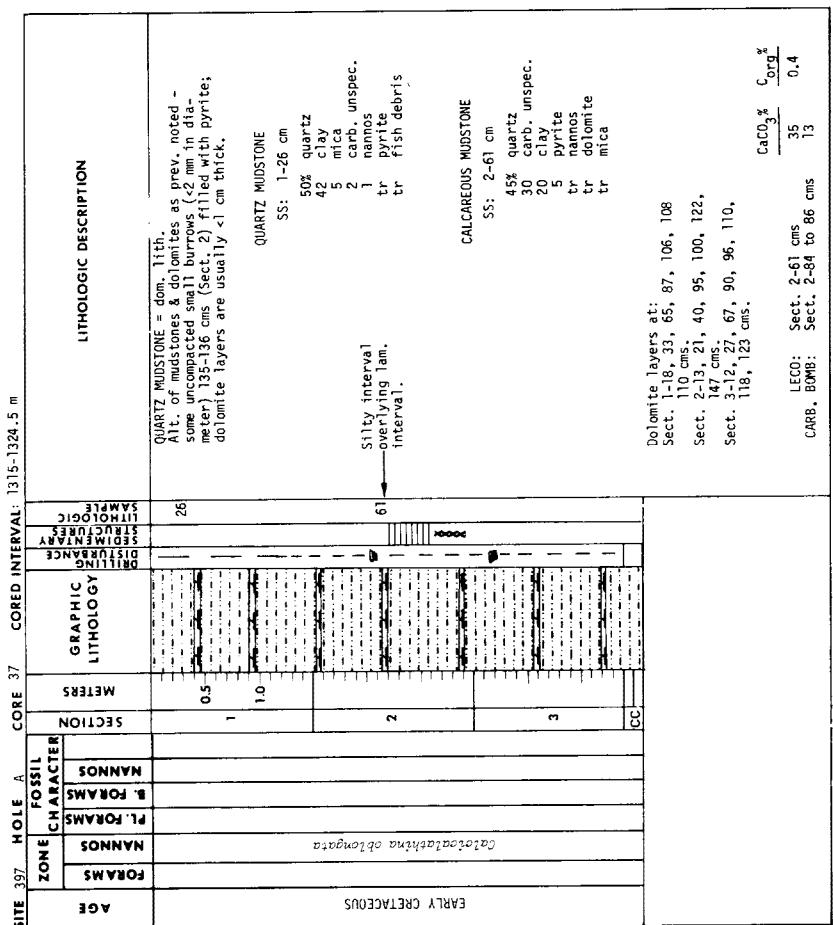
SITE #	MOLE A	CORE #	CORE INTERVAL:	LITHOLOGIC DESCRIPTION	
				GRAPHIC LITHOLOGY	DISCUSSION
327			1210.5-1229.5 m	MUDSTONE SS: 1-30, 45 cms 40-45% clay 20-25 quartz 10-20 silt, unspc. (clst?) (SS: 1-30 cm) 3-10 nannos 5 carb. unspc. tr-3 pyrite 2 fe dispar tr do. (SS: 1-45 cm) tr mica tr calcite collophane(?) (SS: 1-30 cm)	
MUDSTONE					
				SS: 2-96 cm 80% clay 10 nannos 4 carb. unspc. 3 forams 1 mica	
				MUDSTONE	
				LFC: Sect. 1-36 cms CARB. BMM: Sect. 1-37 to 39 cms Sect. 2-103 to 105 cms	CaCO <sub>3</sub> % Corr %
				23 22 15	2.3 2.3 1.5
COLOR LEGEND					
1 = very dk. gy. brn. 2 = dk. gy. brn. 3 = gr. brn. 4 = dk. 3/4 5 = gr. 4/4 6 = gr. 5/5					

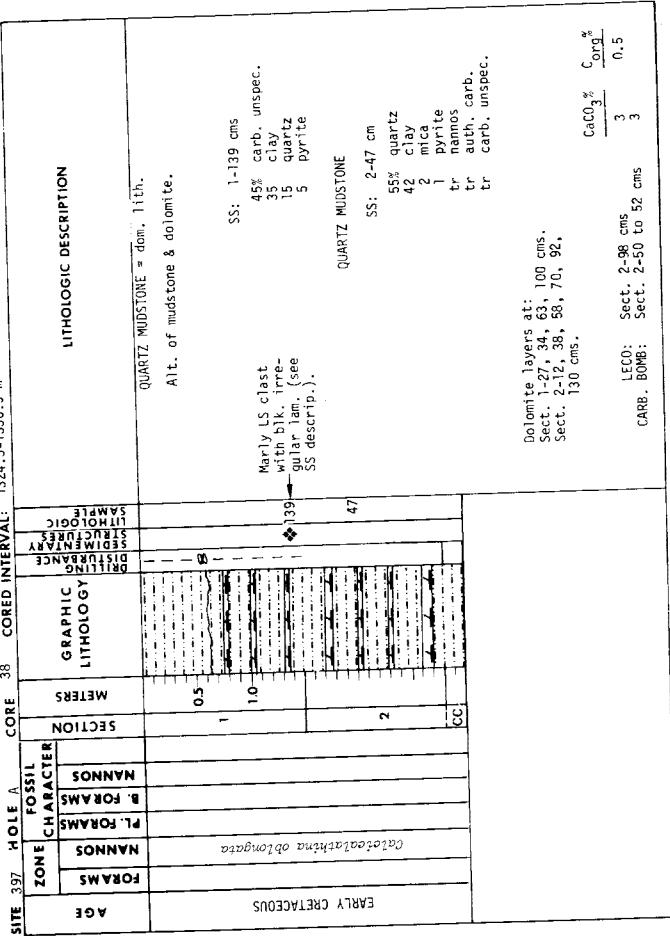
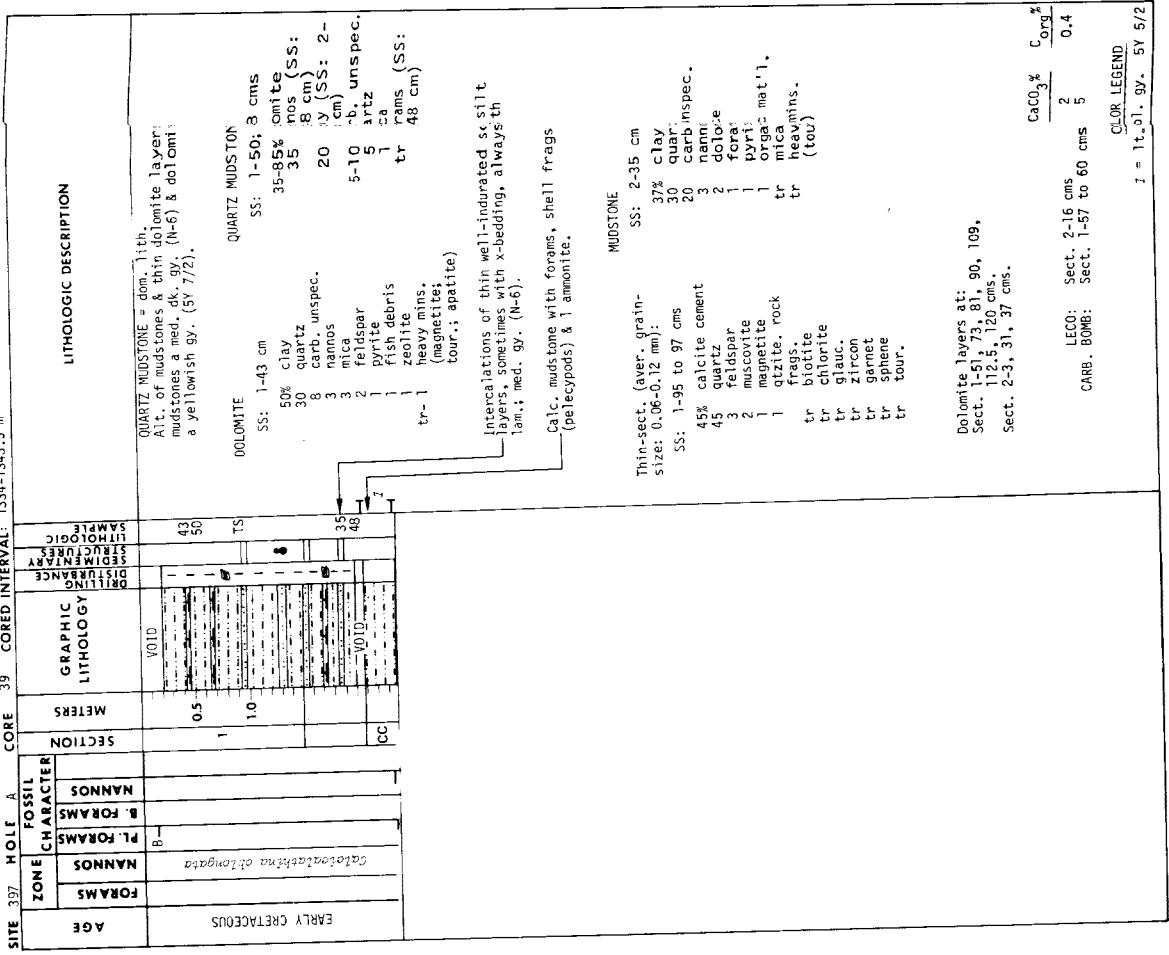
SITE#		HOLE A		CORE 27		CORED INTERVAL: 1299.5-1299 m	
AGE	ZONE	FOSSIL CHARACTER	MATERIAL	SECTION	GRAPHIC LITHOLOGY	DIAULITING DISUBSTRATE	LITHOLOGIC DESCRIPTION
EARLY MIocene	HESIODASTER duryggi	NANNO	FORMAMS	Rp	Rp	Rp	PEBBLY MUDSTONE = dom. lith. Clasts def. - lenticular stretched, often to produce a migmatitic texture; spher. portions (sect. 1-15 to 20 cms, 64 & 78 cms., dips of vague lam. 18 to 25°.
				CC			
							75% namus 15 carb. unspec. 9 quartz 4 pyrite 1 tr mica
							SS: 1-61 Matrix: CLAYSTONE
							LECO: Sect. 1-89 cms 15 CARB. BOMB: Sect. 2-33 to 35 cms 22
							CaCO <sub>3</sub> % C <sub>org</sub> % 16 0.7 22 0.7
							COLOR LEGEND
							I = grn. blk. 2 = lt. bl. sy. 3 = dk. gy. brn. 4 = dk. gy.







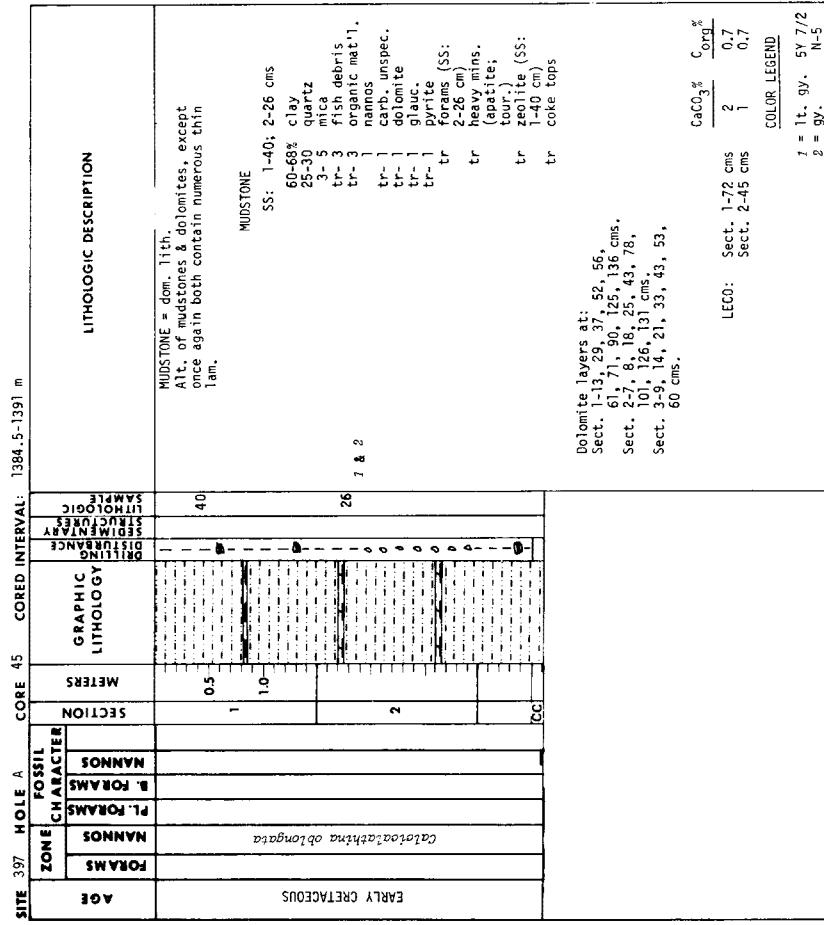
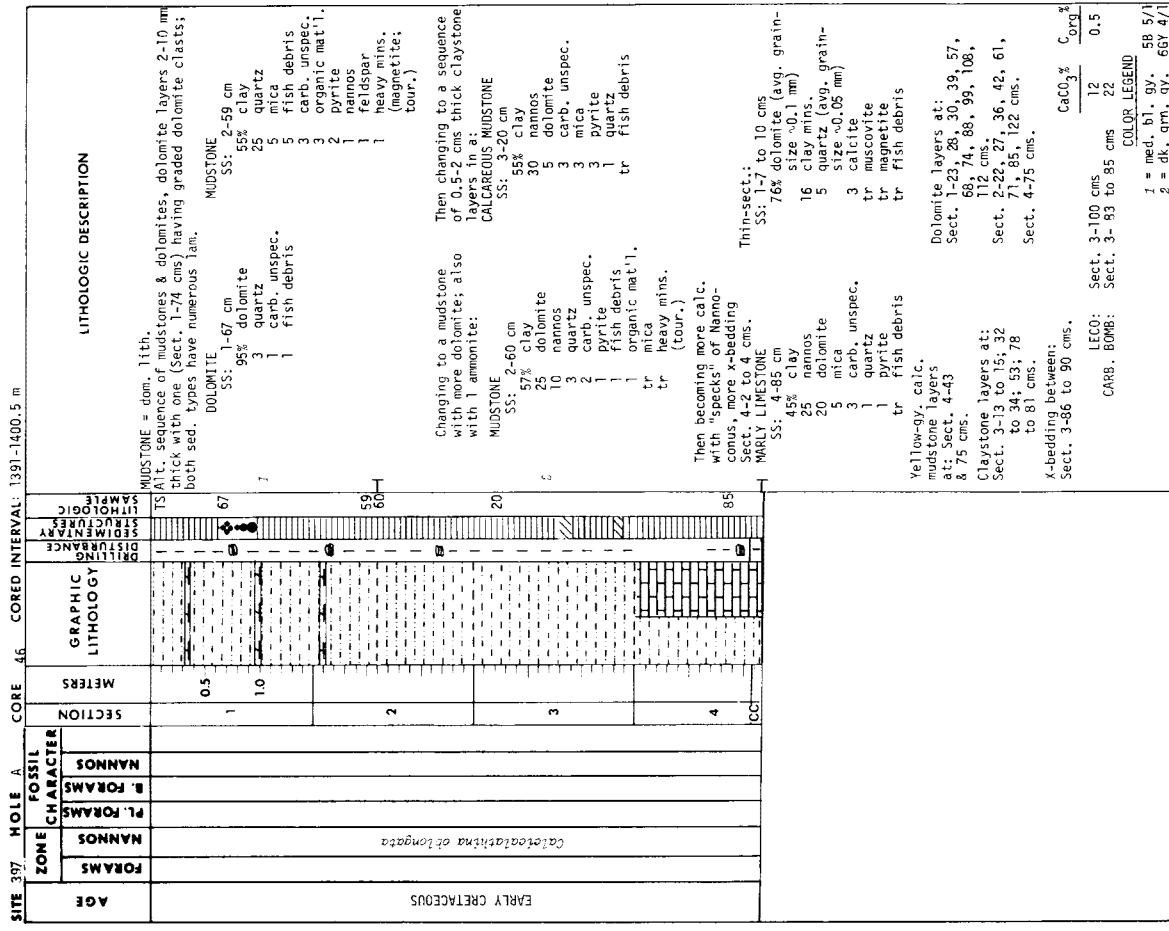




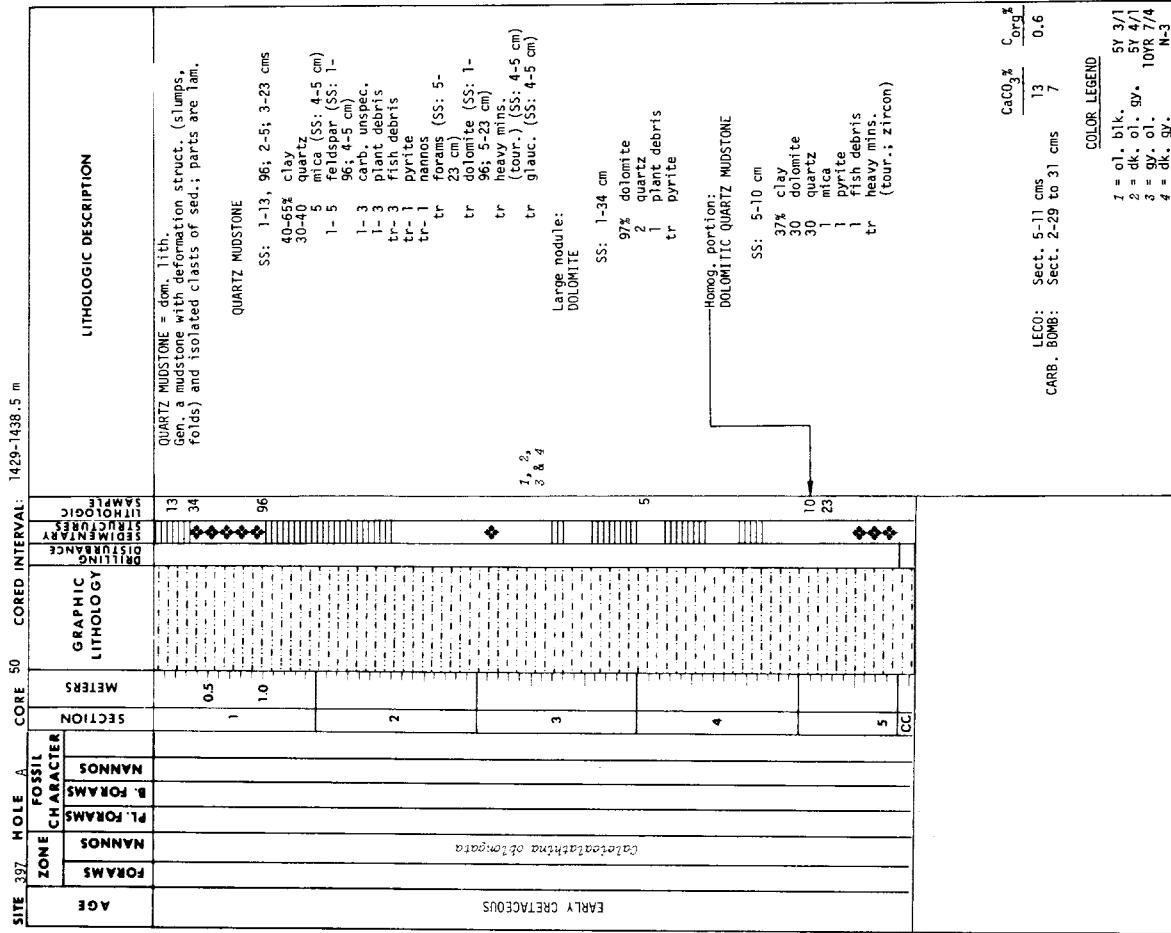
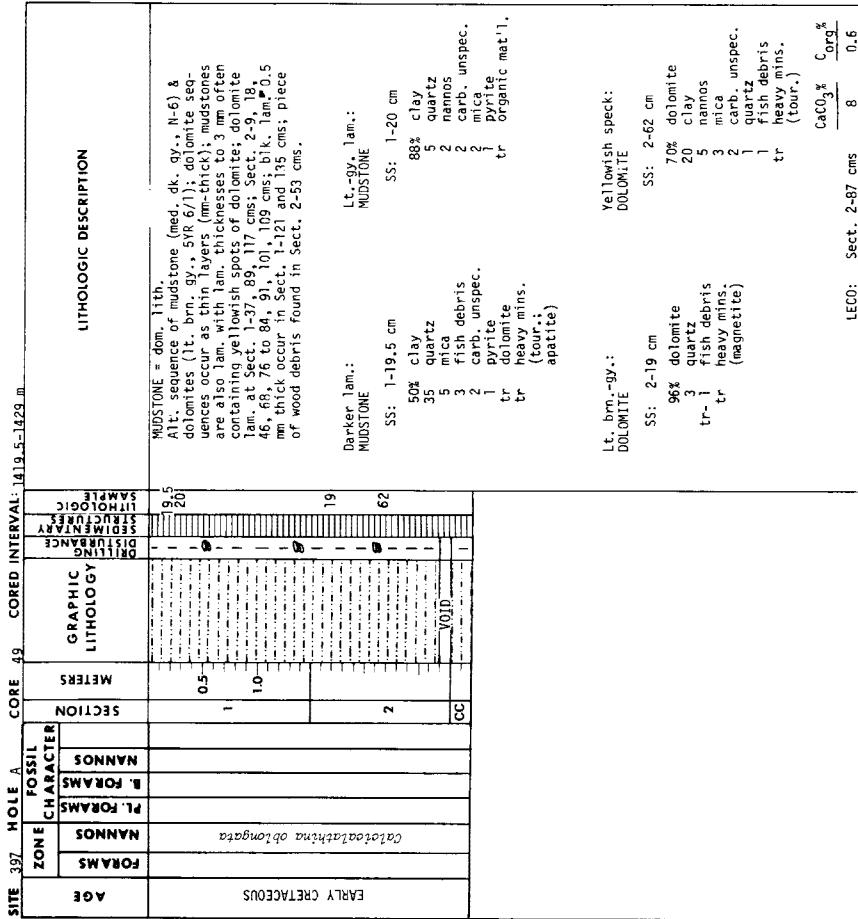


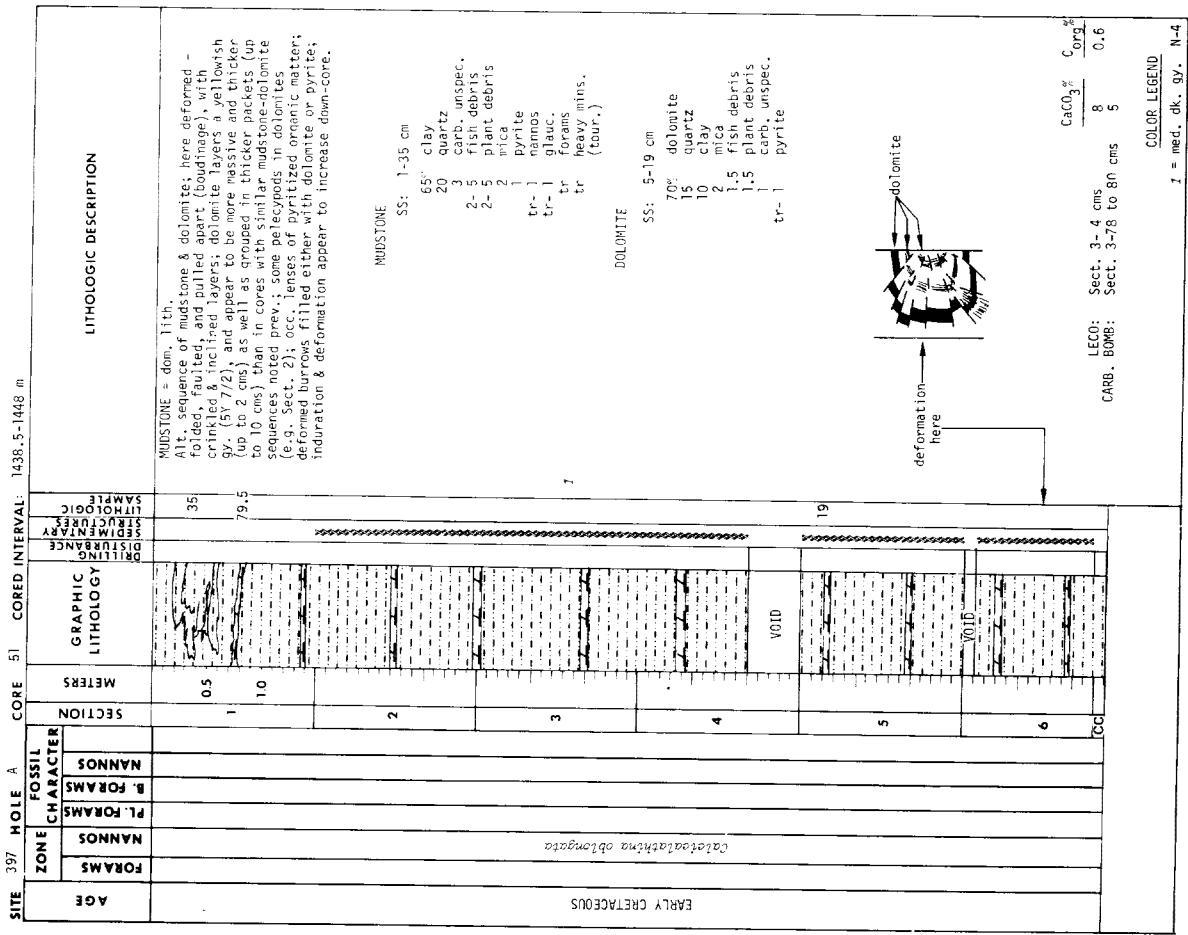
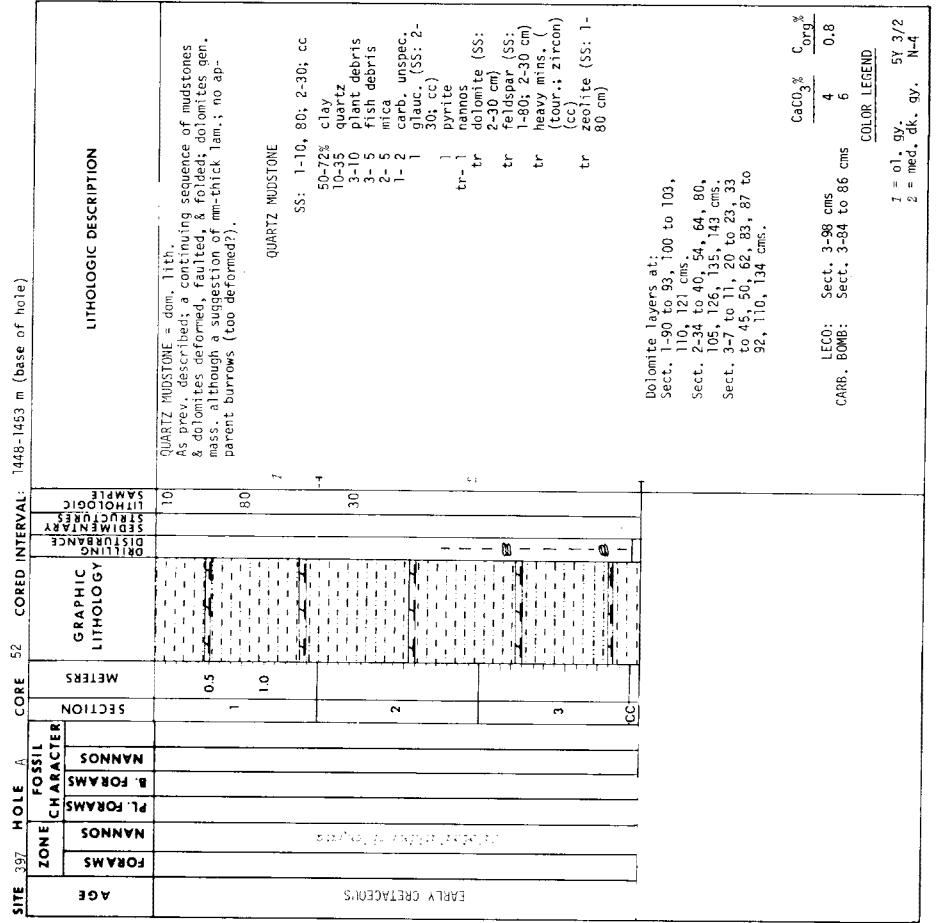
SITE 397		HOLE A	CORE 44	CORED INTERVAL: 1381.5-1384.5 m	LITHOLOGIC DESCRIPTION	
ZONE	FASSIL CHARACTER	SECTION	METERS	GRAPHIC LITHOLOGY	SAMPLE SIZE/THICKNESS	
					DIMINISHING SEMI-TRANSPARENCY	DISSEMELTING
EARLY CRETACEOUS			0.5	60	53-69% clay	QUARTZ MUDSTONE
			1.0		30-45 quartz	
			1.4		1 pyrite (SS: 2-24 cm)	
			2.0		tr- carb. unpec.	
			2.4		tr- fish debris	
			2.8		tr namos.	
			3.2		tr dolomite	
			3.6		tr plant debris (SS: 2-24 cm)	
			CC			
Dolomite layers at: Sect. 2-34, 43 cms.						
LECO:	Sect. 2-65 cms				CaCO <sub>3</sub> %	Org %
CARR. BOMB:	Sect. 1-24 to 27 cms				1	2
COLOR LEGEND						
1	= med. gy. bnm.				5Y 4/2	
2	= med. gy. bnm.				5Y 3/2	

SITE 397 HOLE A		CORE 43	CORED INTERVAL: 1372-1381.5 m		
ZONE CHARACTER	FOSSIL FORMS	SECTION	GRAPHIC LITHOLOGY	LITHOLOGIC DESCRIPTION	
				METERS	SAMPLE NUMBER
NANNOS				1.0	1
B. FORMAMS				0.5	2
PL. FORMAMS				0.5	3
CALOTICALATHETINA oblongata				1.0	4
AGS				1.0	5
NANNOS				1.0	6
B. FORMAMS				1.0	7
PL. FORMAMS				1.0	8
CALOTICALATHETINA oblongata				1.0	9
AGS				1.0	10
NANNOS				1.0	11
B. FORMAMS				1.0	12
PL. FORMAMS				1.0	13
CALOTICALATHETINA oblongata				1.0	14
AGS				1.0	15
NANNOS				1.0	16
B. FORMAMS				1.0	17
PL. FORMAMS				1.0	18
CALOTICALATHETINA oblongata				1.0	19
AGS				1.0	20
NANNOS				1.0	21
B. FORMAMS				1.0	22
PL. FORMAMS				1.0	23
CALOTICALATHETINA oblongata				1.0	24
AGS				1.0	25
NANNOS				1.0	26
B. FORMAMS				1.0	27
PL. FORMAMS				1.0	28
CALOTICALATHETINA oblongata				1.0	29
AGS				1.0	30
NANNOS				1.0	31
B. FORMAMS				1.0	32
PL. FORMAMS				1.0	33
CALOTICALATHETINA oblongata				1.0	34
AGS				1.0	35
NANNOS				1.0	36
B. FORMAMS				1.0	37
PL. FORMAMS				1.0	38
CALOTICALATHETINA oblongata				1.0	39
AGS				1.0	40
NANNOS				1.0	41
B. FORMAMS				1.0	42
PL. FORMAMS				1.0	43
CALOTICALATHETINA oblongata				1.0	44
AGS				1.0	45
NANNOS				1.0	46
B. FORMAMS				1.0	47
PL. FORMAMS				1.0	48
CALOTICALATHETINA oblongata				1.0	49
AGS				1.0	50
NANNOS				1.0	51
B. FORMAMS				1.0	52
PL. FORMAMS				1.0	53
CALOTICALATHETINA oblongata				1.0	54
AGS				1.0	55
NANNOS				1.0	56
B. FORMAMS				1.0	57
PL. FORMAMS				1.0	58
CALOTICALATHETINA oblongata				1.0	59
AGS				1.0	60
NANNOS				1.0	61
B. FORMAMS				1.0	62
PL. FORMAMS				1.0	63
CALOTICALATHETINA oblongata				1.0	64
AGS				1.0	65
NANNOS				1.0	66
B. FORMAMS				1.0	67
PL. FORMAMS				1.0	68
CALOTICALATHETINA oblongata				1.0	69
AGS				1.0	70
NANNOS				1.0	71
B. FORMAMS				1.0	72
PL. FORMAMS				1.0	73
CALOTICALATHETINA oblongata				1.0	74
AGS				1.0	75
NANNOS				1.0	76
B. FORMAMS				1.0	77
PL. FORMAMS				1.0	78
CALOTICALATHETINA oblongata				1.0	79
AGS				1.0	80
NANNOS				1.0	81
B. FORMAMS				1.0	82
PL. FORMAMS				1.0	83
CALOTICALATHETINA oblongata				1.0	84
AGS				1.0	85
NANNOS				1.0	86
B. FORMAMS				1.0	87
PL. FORMAMS				1.0	88
CALOTICALATHETINA oblongata				1.0	89
AGS				1.0	90
NANNOS				1.0	91
B. FORMAMS				1.0	92
PL. FORMAMS				1.0	93
CALOTICALATHETINA oblongata				1.0	94
AGS				1.0	95
NANNOS				1.0	96
B. FORMAMS				1.0	97
PL. FORMAMS				1.0	98
CALOTICALATHETINA oblongata				1.0	99
AGS				1.0	100
NANNOS				1.0	101
B. FORMAMS				1.0	102
PL. FORMAMS				1.0	103
CALOTICALATHETINA oblongata				1.0	104
AGS				1.0	105
NANNOS				1.0	106
B. FORMAMS				1.0	107
PL. FORMAMS				1.0	108
CALOTICALATHETINA oblongata				1.0	109
AGS				1.0	110
NANNOS				1.0	111
B. FORMAMS				1.0	112
PL. FORMAMS				1.0	113
CALOTICALATHETINA oblongata				1.0	114
AGS				1.0	115
NANNOS				1.0	116
B. FORMAMS				1.0	117
PL. FORMAMS				1.0	118
CALOTICALATHETINA oblongata				1.0	119
AGS				1.0	120
NANNOS				1.0	121
B. FORMAMS				1.0	122
PL. FORMAMS				1.0	123
CALOTICALATHETINA oblongata				1.0	124
AGS				1.0	125
NANNOS				1.0	126
B. FORMAMS				1.0	127
PL. FORMAMS				1.0	128
CALOTICALATHETINA oblongata				1.0	129
AGS				1.0	130
NANNOS				1.0	131
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PL. FORMAMS				1.0	133
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AGS				1.0	135
NANNOS				1.0	136
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PL. FORMAMS				1.0	138
CALOTICALATHETINA oblongata				1.0	139
AGS				1.0	140
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NANNOS				1.0	146
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PL. FORMAMS				1.0	148
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AGS				1.0	150
NANNOS				1.0	151
B. FORMAMS				1.0	152
PL. FORMAMS				1.0	153
CALOTICALATHETINA oblongata				1.0	154
AGS				1.0	155
NANNOS				1.0	156
B. FORMAMS				1.0	157
PL. FORMAMS				1.0	158
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AGS				1.0	160
NANNOS				1.0	161
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PL. FORMAMS				1.0	163
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AGS				1.0	165
NANNOS				1.0	166
B. FORMAMS				1.0	167
PL. FORMAMS				1.0	168
CALOTICALATHETINA oblongata				1.0	169
AGS				1.0	170
NANNOS				1.0	171
B. FORMAMS				1.0	172
PL. FORMAMS				1.0	173
CALOTICALATHETINA oblongata				1.0	174
AGS				1.0	175
NANNOS				1.0	176
B. FORMAMS				1.0	177
PL. FORMAMS				1.0	178
CALOTICALATHETINA oblongata				1.0	179
AGS				1.0	180
NANNOS				1.0	181
B. FORMAMS				1.0	182
PL. FORMAMS				1.0	183
CALOTICALATHETINA oblongata				1.0	184
AGS				1.0	185
NANNOS				1.0	186
B. FORMAMS				1.0	187
PL. FORMAMS				1.0	188
CALOTICALATHETINA oblongata				1.0	189
AGS				1.0	190
NANNOS				1.0	191
B. FORMAMS				1.0	192
PL. FORMAMS				1.0	193
CALOTICALATHETINA oblongata				1.0	194
AGS				1.0	195
NANNOS				1.0	196
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PL. FORMAMS				1.0	198
CALOTICALATHETINA oblongata				1.0	199
AGS				1.0	200
NANNOS				1.0	201
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PL. FORMAMS				1.0	203
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AGS				1.0	205
NANNOS				1.0	206
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AGS				1.0	210
NANNOS				1.0	211
B. FORMAMS				1.0	212
PL. FORMAMS				1.0	213
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AGS				1.0	215
NANNOS				1.0	216
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NANNOS				1.0	221
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AGS				1.0	225
NANNOS				1.0	226
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CALOTICALATHETINA oblongata				1.0	229
AGS				1.0	230
NANNOS				1.0	231
B. FORMAMS				1.0	232
PL. FORMAMS				1.0	233
CALOTICALATHETINA oblongata				1.0	234
AGS				1.0	235
NANNOS				1.0	236
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AGS				1.0	240
NANNOS				1.0	241
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PL. FORMAMS				1.0	243
CALOTICALATHETINA oblongata				1.0	244
AGS				1.0	245
NANNOS				1.0	246
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PL. FORMAMS				1.0	248
CALOTICALATHETINA oblongata				1.0	249
AGS				1.0	250
NANNOS				1.0	251
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PL. FORMAMS				1.0	253
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AGS				1.0	255
NANNOS				1.0	256
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PL. FORMAMS				1.0	258
CALOTICALATHETINA oblongata				1.0	259
AGS				1.0	260
NANNOS				1.0	261
B. FORMAMS				1.0	262
PL. FORMAMS				1.0	263
CALOTICALATHETINA oblongata				1.0	264
AGS				1.0	265
NANNOS				1.0	266
B. FORMAMS				1.0	267
PL. FORMAMS				1.0	268
CALOTICALATHETINA oblongata				1.0	269
AGS				1.0	270
NANNOS				1.0	271
B. FORMAMS				1.0	272
PL. FORMAMS				1.0	273
CALOTICALATHETINA oblongata				1.0	274
AGS				1.0	275
NANNOS				1.0	276
B. FORMAMS				1.0	277
PL. FORMAMS				1.0	278
CALOTICALATHETINA oblongata				1.0	279
AGS				1.0	280
NANNOS				1.0	281
B. FORMAMS				1.0	282
PL. FORMAMS				1.0	283
CALOTICALATHETINA oblongata				1.0	284
AGS				1.0	285
NANNOS				1.0	286
B. FORMAMS				1.0	287
PL. FORMAMS				1.0	288
CALOTICALATHETINA oblongata			</		









# INITIAL CORE DESCRIPTIONS

## DEEP SEA DRILLING PROJECT

### LEG 47B

12 April — 12 May 1976

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A Project Planned by and Carried Out With the Advice of the  
JOINT OCEANOGRAPHIC INSTITUTIONS FOR DEEP EARTH SAMPLING (JOIDES)

#### MEMBER ORGANIZATIONS

Institute of Geophysics, University of Hawaii  
Lamont-Doherty Geological Observatory, Columbia University  
School of Oceanography, Oregon State University  
Graduate School of Oceanography, University of Rhode Island  
Rosenstiel School of Marine and Atmospheric Sciences, University of Miami  
Scripps Institution of Oceanography, University of California  
Department of Oceanography, Texas A & M University  
University of Washington  
Woods Hole Oceanographic Institution  
National Environment Research Council, London  
Centre National Pour L'Exploitation Des Oceans, Paris  
Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover  
Ocean Research Institute, University of Tokyo  
USSR Academy of Sciences, P. P. Shirshov Institute of Oceanology, Moscow

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#### PARTICIPATING SCIENTISTS

William Ryan, Jean Claude Sibuet, Michael Arthur,  
Ross Barnes, Gretchen Blechschmidt, Dan Habib,  
Silvia Iaccarino, David Johnson, I. S. Lopatin,  
Andres Maldonado, David G. Moore, G. E. Morgan,  
J. P. Rehault, Jacques Sigal, Carol Williams

## LEG 47B SUMMARY

### Introduction

Leg 47B concentrated its efforts entirely on a single drillsite west of Portugal in the North Atlantic. This site (398) is situated in the axis of a half graben in the acoustic basement near the base of a small elevated crustal block about half-way between the mainland of the Iberian continent and Galicia Bank (Figure 1). This elevated feature is non-magnetic and is known as Vigo Seamount.

Multiple re-entry was attempted and accomplished successfully permitting an ultimate penetration of 1740 meters sub-bottom in a water depth of 3890 meters. Drilling was terminated after a last-minute three-day extension when it was confirmed by the shipboard team that the latest cores contained limestones laid down in an epi-continental setting near the time of the main phase of tensional pull-apart, and prior to the initiation of rapid downward flexure of the adjacent margin of Portugal.

Twenty-five days were spent on site with the Glomar Challenger, departing Vigo, Spain on April 12 and arriving in Brest, France on May 12, 1976.

Five separate holes were drilled. The first was started as a pilot hole to evaluate the ability of the uppermost 100 meters to support the re-entry cone and casing. It was abandoned with a parted sand-line necessitating round tripping the entire string. Hole 398A was terminated due to bad weather and Hole 398B with another parted sandline. The cone was, in fact, not implaced until after the drilling vessel had been on site for one week. Hole 398C involved a first attempt to wash in the casing, which had to be abandoned because of uncertainty of whether the cone had actually come into contact with the seafloor or not. Practically all the principal scientific results were generated from Hole 398D.

### BACKGROUND AND OBJECTIVES

The Galicia region was considered by the JOIDES Passive Margin Advisory Panel as belonging to the continental margin province of the eastern North Atlantic. The attractiveness of the Galicia region for the first attempt at very deep drilling in IPOD Phase I focused on the general absence of major offshore deltas along the western coast of Portugal, and hence the likelihood of encountering a thinner blanket of Mesozoic and Cenozoic sediments than exists on the northwest African Margin.

A prolonged subsidence in the Galicia region of marine sediments originally deposited in shallow, sun-lit epicontinental seaways is confirmed by several dredge hauls containing Jurassic age limestones obtained from the summits and around the marginal escarpments of both Galicia Bank and Vigo Seamount. The sialic nature of the underlying bedrock of the prominences is similarly demonstrated by the sampling of feldspathic gneisses, granodiorites and granites.

One of the principal objectives of drilling at Site 398 was to obtain new information on the age when continental fragmentation began, the timing of the collapse of the epi-continent sea that was accompanied by the rotation of large fault blocks observed on the seismic profiles, and the rate of continental margin subsidence that followed the inception of seafloor spreading between Iberia and Newfoundland.

The choice of the axial position within the half-graben target area provided a better chance of recovering a more complete stratigraphic section than exists on the upturned horsts and far greater security against an entrapment situation of liquid hydrocarbons. Four major acoustic units were defined in the pre-site reflection profiling surveys of IFP-CNEXO and are illustrated on the accompanying sketch of seismic profile GP19 which passes about 0.4 miles north of the drillsite (Figure 2). Drilling terminated within or near the base of Acoustic Unit #4.

#### PRINCIPAL RESULTS

Five major lithologic units are differentiated. Unit 1 is a marly nanno-fossil ooze to siliceous marly chalk of Pleistocene to early Oligocene age (0-590 meters subbottom). Rhythmic bedding is conspicuous, indicating both dilution and dissolution cycles. Unit 2 is a siliceous marly chalk to mudstone of Eocene to early Paleocene age (590-775 meters) characterized by abundant zeolites, moderately low carbonate contents, and numerous thin sand and silt layers reflecting deposition of reworked deep-sea sediments by both downslope turbidity currents and traction transporting benthic boundary currents. Unit 3 is a calcareous mudstone, alternating with a marly chalk and grading downward to a red, barren mudstone of early Paleocene to Campanian age (775-945 meters). It is rich in fine-grained quartz and mica and was, in part, deposited near or below the CCD. Unit 4 is a dark laminated and only occasionally bioturbated mudstone to claystone grading down into dark organic shales with thin dolomitic laminae and lenses (some having the appearance of algal stromalolite-like accretionary mounds. It terminates in thin turbiditic sandstones, siltstones and calcareous mudflow-debris flow strata with associated mudchip conglomerates of Cenomanian to early Barremian age (945-1668 meters). Unit 5 contains fine-grained, nannofossil limestone of Hauterivian age (1668-1740 meters) interbedded in varved brown mudstone devoid of benthic remains and trace fossils. The evolution of water depths and depositional environments is not unambiguous. The presence of stromalolite-like structures and extremely well preserved ammonites and other molluscs in the extremely rapid sedimentation rate ( 100 m/m.y.) Aptian to early Albian interval, on the one hand, suggests a moderately shallow and partly sun-lit sea floor. However, the co-occurrence of Radiolaria and "primitive" arenaceous benthonic foraminifera,

with only intermittent levels bearing planktonic foraminifera, is alternately explained with a deep sedimentary basin near or below the CCD periodically supplied by turbidity currents and debris flows from upslope regions on the continental margin.

The interpretation of the Cenozoic sequence is somewhat more straight forward with the attainment of a genuine deep-sea situation receiving calcareous-rich allochthonous sediment from the flanking escarpments of Vigo Seamount, as well as Radiolaria, zeolites, quartz, mica and other components in swift bottom currents capable of scouring and sculpturing erosional bed forms such as abyssal furrows and drifts. Dissolution cycles and the rhythmic input of hemipelagic clays are thought to be diagnostic of a climatic influence on abyssal circulation, eustatic sea-level fluctuations, and the run off of coastal streams and deltas into the heads of submarine canyons.

Stratigraphic gaps induced by the erosion of ocean bottom currents and/or non-deposition were detected in the late to middle Miocene, early Paleocene and between the Campanian and the Cenomanian stages of the Cretaceous. A small hiatus might be present also in the vicinity of the Cretaceous-Tertiary boundary.

Measurements of remanent magnetization permit the detection of numerous changes in the earth's magnetic polarity during the Tertiary and Late Cretaceous. However, the entire pre-Campanian is of a single polarity, part of which may represent the long Cretaceous normal Epoch and part of which may be an overprint of this Epoch on earlier sediments which had at one time experienced reversals of the earth's magnetic field. A downhole measurement indicates an anomalously low temperature gradient of  $1^{\circ}\text{C}$  per 100 meters. No volumetrically significant hydrocarbon gases were detected from apparently thermally immature sediments, even though the early Cretaceous strata possess organic carbon contents of up to 3 or more percent by weight.

Correlation of the drill cores to the acoustic profile was not adequately resolved aboard ship. Two slightly different interpretations are presented in Figure 2 expressing different judgments of compressional wave velocities and different criteria as to the assignment of stratigraphic gaps with observed reflector pinch out and onlap sequences. Basically both interpretations indicate that Acoustic Unit #1 is Neogene in age, the base of Unit #2 is Campanian in age, and the base of Acoustic Unit #3 is Aptian in age. However, according to one interpretation, the base of the hole is midway into Acoustic Unit #4, and with the other the base of the hole is just below the base of Unit #4.

In the Galicia region west of Portugal Acoustic Unit #4 is found only beneath the continental slope province. It has a restricted distribution which points towards its deposition prior to the generation of oceanic crust north of the Newfoundland Fracture Zone. The Site 398 drilling results appear comparable with both Acoustic Unit #4 and even the lower part of Unit #3, having accumulated in epicontinental environments as part of a broad seaway linking Europe to North America.

The Leg 47B cores however were not able to shed much light either on the time of onset of initial basement collapse west of Portugal or the rate of subsidence. In addition, little insight was provided as to the questions related to the geometry of pre-drift reconstructions in this area.

Perhaps one of the most significant discoveries is a major erosional phase just prior to the Campanian which the shipboard team felt might be related to the initial widening of the Rockall Trough to the north and the establishment of a transport route for cold bottom water from the Late Cretaceous North Sea and Barents shelf regions.

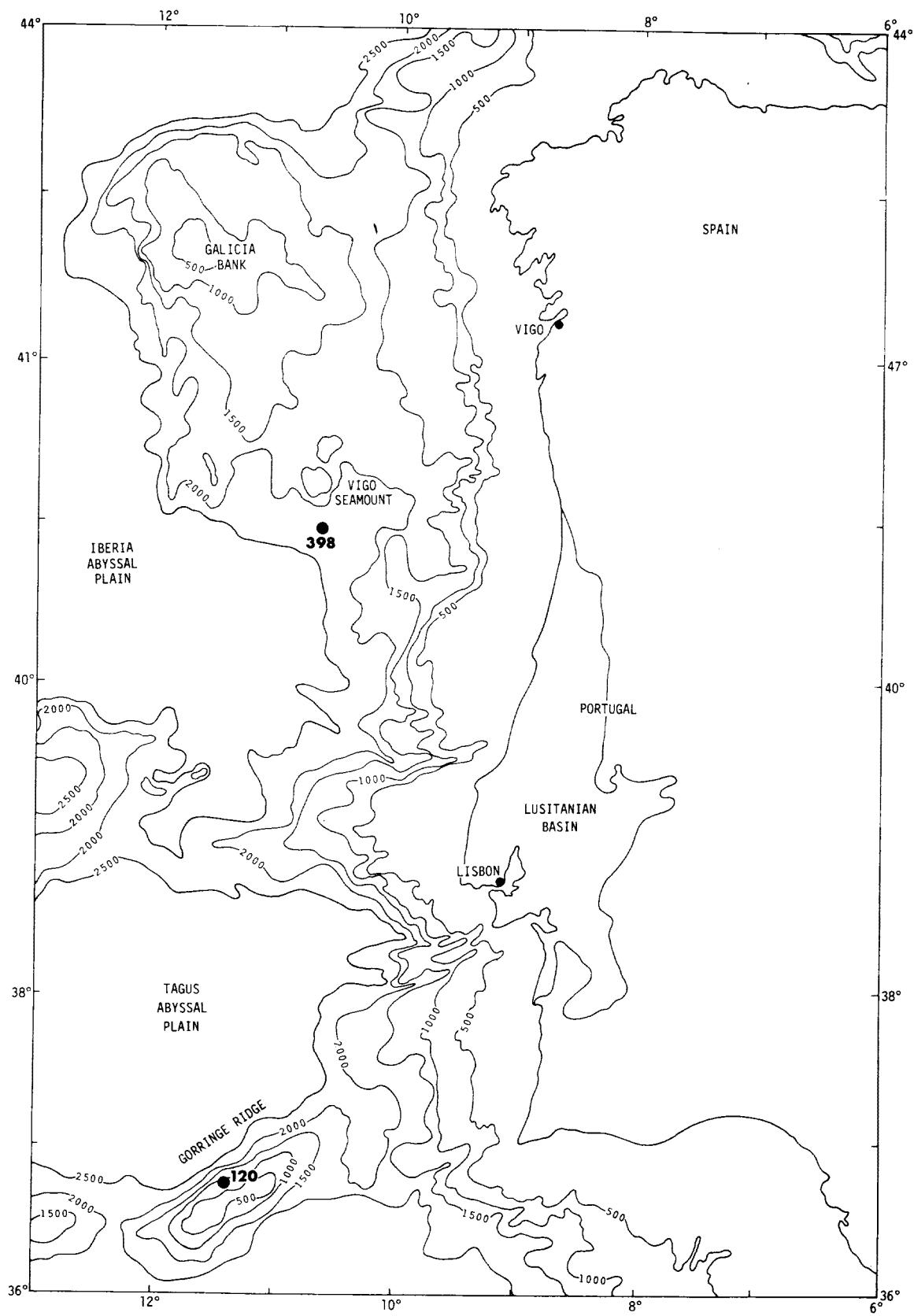


FIGURE 1. Topography of area of Site 398.

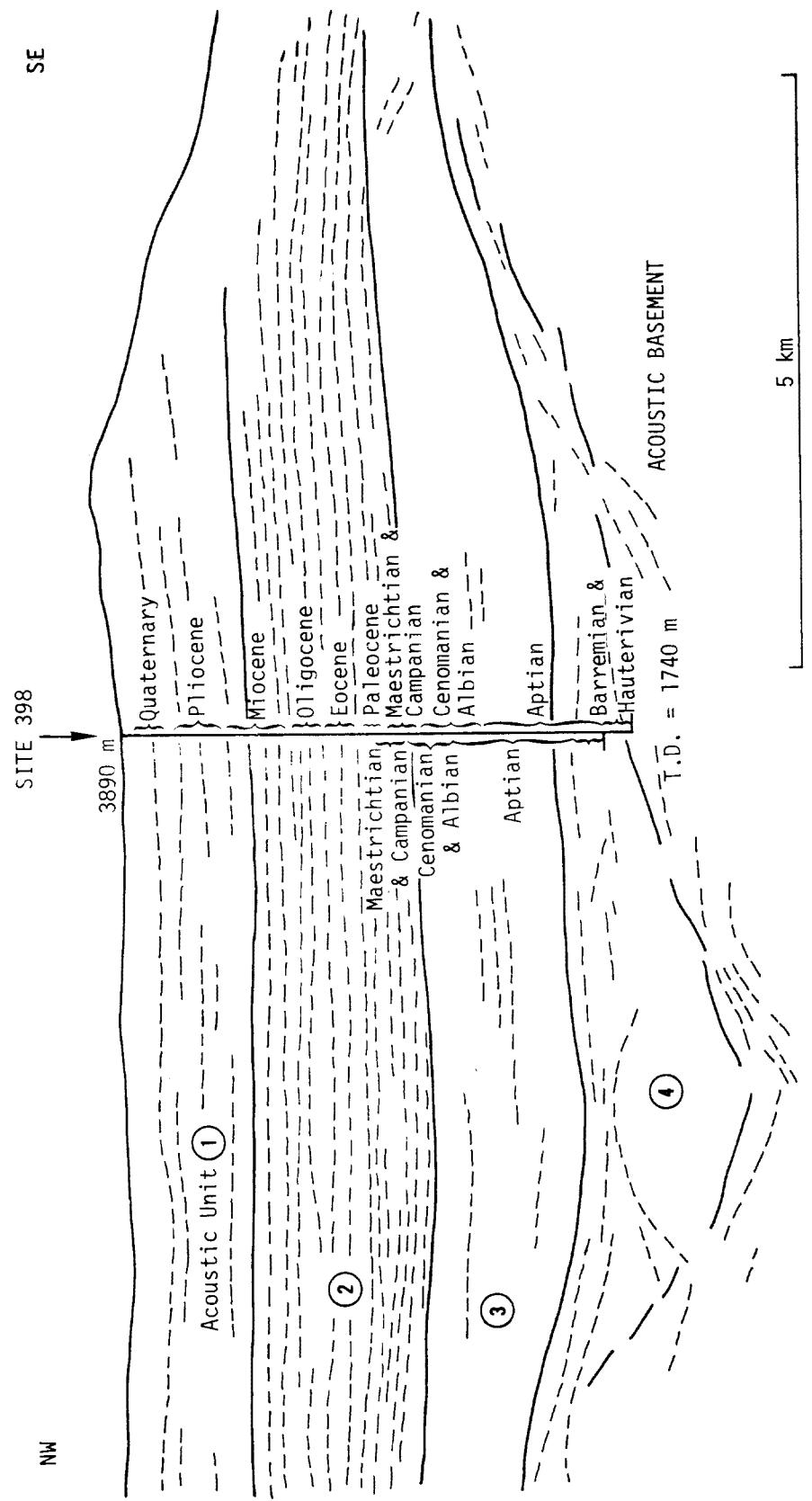


FIGURE 2. Seismic profile (diagrammatic)  
at Site 398.

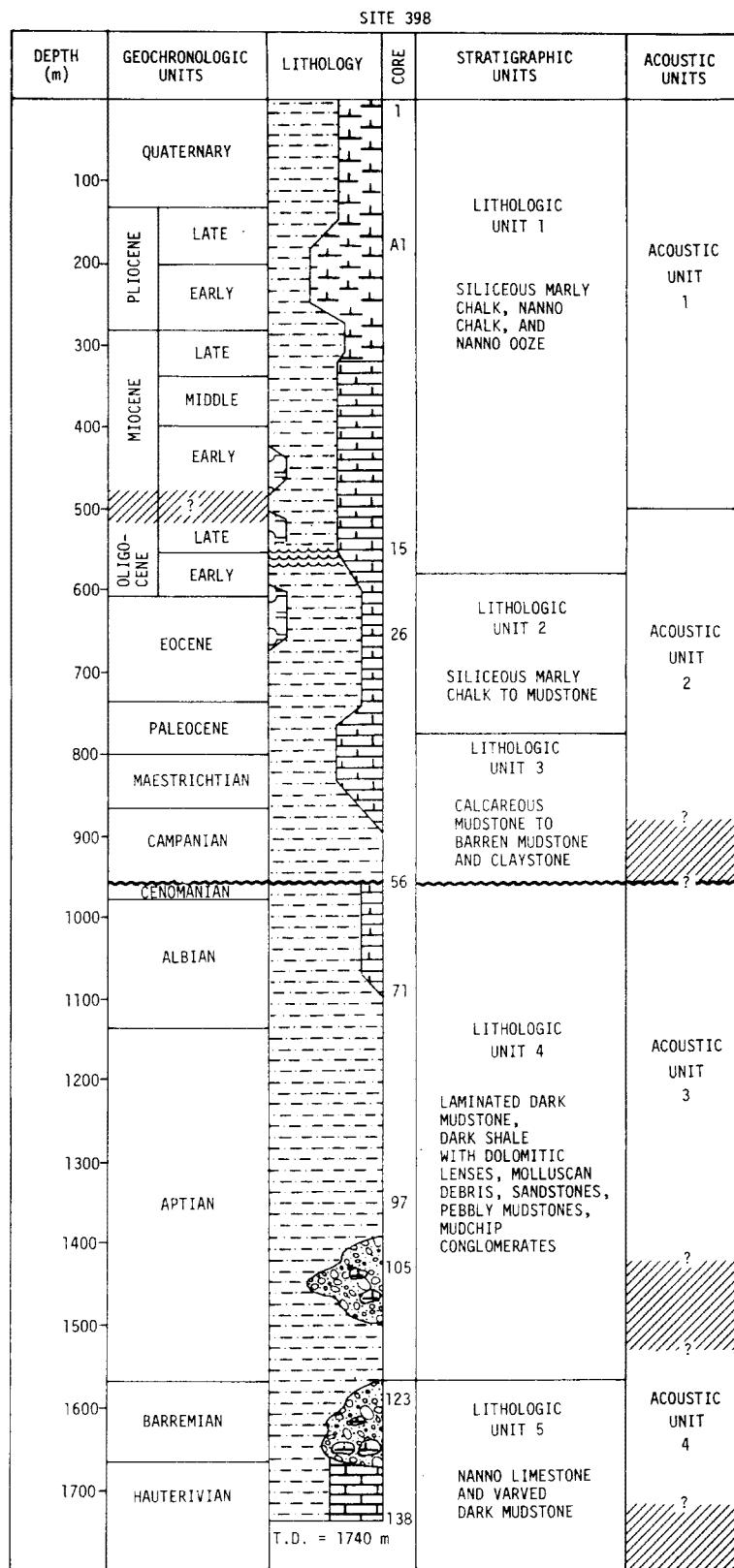


FIGURE 3. Age, lithology, stratigraphic and acoustic units - Site 398.

## EXPLANATORY NOTES

### Introduction

Persons wishing to obtain samples are directed to the DSDP-NSF sample distribution policy (reproduced here, p. 9). Sample requests must be submitted on standard DSDP request forms which may be obtained from:

The Curator  
Deep Sea Drilling Project A-031  
University of California, San Diego  
La Jolla, California 92093

The following material is intended as an aid in understanding:

- (1) the terminology, labeling, and numbering conventions used by the Deep Sea Drilling Project;
- (2) the sediment classification and biostratigraphic framework used on Leg 47B; and
- (3) the presentation of the lithologic and paleontologic data on the core forms which make up much of this publication.

### Numbering of Sites, Hole, Cores, Samples

Drill site numbers run consecutively from the first site drilled by *Glomar Challenger* in 1968; the site number is thus unique. A site refers to the hole or holes drilled from one acoustic positioning beacon. Several holes may be drilled at a single locality by pulling the drill string above the sea floor ("mud line") and offsetting the ship some distance (usually 100 meters or more) from the previous hole.

The first (or only) hole drilled at a site takes the site number. Additional holes at the same site are further distinguished by a letter suffix. The first hole has only the site number; the second has the site number with suffix A; the third has the site number with suffix B; and so forth. It is important, for sampling purposes, to distinguish the holes drilled at a site, since recovered sediments or rocks usually do not come from equivalent positions in the stratigraphic column at different holes.

Cores are numbered sequentially from the top down. In the ideal case, they consist of 9.3 meters of sediment or rock in a plastic liner of 6.6 cm diameter. In addition, a short sample is obtained from the core catcher (a multi-fingered device at the bottom of the core barrel which prevents cored materials from sliding out during core-barrel recovery). This usually amounts to about 0.2 meters of sediment or rock.

## SAMPLE DISTRIBUTION POLICY

### Deep Sea Drilling Project/International Phase of Ocean Drilling

Distribution of Deep Sea Drilling samples for investigation will be undertaken in order to (1) provide supplementary data to support GLOMAR CHALLENGER scientists in achieving the scientific objectives of their particular cruise, and in addition to serve as a mechanism for contributions to the INITIAL REPORTS; (2) provide individual investigators with materials to conduct detailed studies beyond the scope of the Initial Reports; and (3) provide the reference centers where paleontologic materials are stored with samples for reference and comparison purposes.

The National Science Foundation has established a Sample Distribution Panel to advise on the distribution of core materials. This panel is chosen in accordance with usual Foundation practices, in a manner that will assure advice in the various disciplines leading to a complete and adequate study of the cores and their contents. Funding for the proposed research must be secured separately by the investigator. It cannot be provided through the Deep Sea Drilling Project.

The Deep Sea Drilling Project's Curator is responsible for distributing the samples and controlling their quality, as well as preserving and conserving core material. He also is responsible for maintaining a record of all samples that have been distributed, shipboard and subsequent, indicating the recipient, and the natures of the proposed investigation. This information is made available to all investigators of DSDP materials as well as other interested researchers on request.

The distribution of samples is made directly from one of the two existing repositories, Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography, by the Curator or his designated representative.

#### 1. Distribution of Samples for Research Leading to Contributions to Initial Reports

Any investigator who wishes to contribute a paper to a given volume of the Initial Reports may write to the Chief Scientist, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A., requesting samples from a forthcoming cruise. Requests for a specific cruise should be received by the Chief Scientist TWO MONTHS in advance of the departure of the cruise in order to allow time for the review and consideration of all requests and to establish a suitable shipboard sampling program. The request should include a statement of the nature of the study proposed, size and approximate number of samples required to complete the study, and any particular sampling technique or equipment that might be required. The requests will be reviewed by the Chief Scientist of the Project and the cruise co-chief scientists; approval will be given in accordance with the scientific requirements of the cruise as determined by the appropriate JOIDES Advisory Panel(s). If approved, the requested samples will be taken, either by the shipboard party if the workload permits, or by the curatorial staff shortly following the return of the cores to the repository. Proposals must be of a scope to ensure that samples can be processed and a contribution completed in time for publication in the Initial Reports. Except for rare, specific instances involving ephemeral properties, sampling will not exceed one-quarter of the volume of core recovered, with no interval being depleted and one-half of all core being retained as an archive. Shipboard sampling shall not exceed approximately 100 igneous samples per investigator; in all cases co-chief scientists are requested to keep sampling to a minimum.

The co-chief scientists may elect to have special studies of selected core samples made by other investigators. In this event the names of these investigators and complete listings of all materials loaned or distributed must be forwarded, if possible, prior to the cruise or, as soon as possible following the cruise, to the Chief Scientist

through the DSDP Staff Science Representative for that particular cruise. In such cases, all requirements of the Sample Distribution Policy shall also apply.

If a dispute arises or if a decision cannot be reached in the manner prescribed, the NSF Sample Distribution Panel will conduct the final arbitration.

Any publication of results other than in the Initial Reports within twelve (12) months of the completion of the cruise must be approved and authored by the whole shipboard party and, where appropriate, shore-based investigators. After twelve months, individual investigators may submit related papers for open publication provided they have submitted their contributions to the Initial Reports. Investigations not completed in time for inclusion in the Initial Reports for a specific cruise may not be published in other journals until final publication of that Initial Report for which it was intended. Notice of submission to other journals and a copy of the article should be sent to the DSDP Chief Science Editor.

#### 2. Distribution of Samples for Research Leading to Publication other than in Initial Reports

A. Researchers intending to request samples for studies beyond the scope of the Initial Reports should first obtain sample request forms from the Curator, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A. On the forms the researcher is requested to specify the quantities and intervals of the core required, make a clear statement of the proposed research, state time required to complete and submit results for publication, specify the status of funding and the availability of equipment and space foreseen for the research.

In order to ensure that all requests for highly desirable but limited samples can be considered, approval of requests and distribution of samples will not be made prior to 2 months after publication of the Initial Core Descriptions (I.C.D.). ICD's required to be published within 10 months following each cruise. The only exceptions to this policy will be for specific instances involving ephemeral properties. Requests for samples can be based on the Initial Core Descriptions, copies of which are on file at various institutions throughout the world. Copies of original core logs and data are kept on file at DSDP and at the Repository at Lamont-Doherty Geological Observatory, Palisades, New York. Requests for samples from researchers in industrial laboratories will be handled in the same manner as these from academic organizations, with the same obligation to publish results promptly.

B. (1) The DSDP Curator is authorized to distribute samples up to 50 ml per meter of core. Requests for volumes of material in excess of this amount will be referred to the NSF Sample Distribution Panel for review and approval. Experience has shown that most investigations can be accomplished with 10ml sized samples or less. All investigators are encouraged to be as judicious as possible with regard to sample size and, especially, frequency within any given core interval. The Curator will not automatically distribute any parts of the cores which appear to be in particularly high demand; requests for such parts will be referred to the Sample Distribution Panel for review. Requests for samples from thin layers or important stratigraphic boundaries will also require Panel review.

(2) If investigators wish to study certain properties which may deteriorate prior to the normal availability of his samples, they may request that the normal waiting period not apply. All such requests must be reviewed by the curators and approved by the NSF Sample Distribution Panel.

C. Samples will not be provided prior to assurance that funding for sample studies either exists or is not needed. However, neither formal approval of sample

requests nor distribution of samples will be made until the appropriate time (Item A). If a sample request is dependent, either wholly or in part, on proposed funding, the organization to whom the funding proposal has been submitted any information on the availability (or potential availability) of samples that it may request.

D. Investigators receiving samples are responsible for:

(1) publishing significant results; however contributions shall not be submitted for publication prior to 12 months following the termination of the appropriate leg;

(2) acknowledging, in publications, that samples were supplied through the assistance of the U.S. National Science Foundation and others as appropriate;

(3) submitting five (5) copies (for distribution to the Curator's file, the DSDP Repositories, the GLOMAR CHALLENGER's Library, and the National Science Foundation) of all reprints of published results to the Curator, Deep Sea Drilling Project (A-012), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A.;

(4) returning, in good condition, the remainders of samples after termination of research, if requested by the Curator.

E. Cores are made available at repositories for investigators to examine and to specify exact samples in such instances as may be necessary for the scientific purposes of the sampling, subject to the limitations of B (1 and 2) and D, above, with specific permission of the Curator or his delegate.

F. Shipboard-produced smear slides of sediments and thin sections of indurated sediments, igneous and metamorphic rocks, will be returned to the appropriate repository at the end of each cruise or at the publication of the Initial Reports for that cruise. These smear slides and thin sections will form a reference collection of the cores stored at each repository and may be viewed at the respective repositories as an aid in the selection of core samples.

G. The Deep Sea Drilling Project routinely processes by computer most of the quantitative data presented in the Initial Reports. Space limitations in the Initial Reports preclude the detailed presentation of all such data. However, copies of the computer readout are available for those who wish the data for further analysis or as an aid in selecting samples. A charge will be made to recover expenses in excess of \$50.00 incurred in filling requests.

#### 3. Other Records

Magnetics, seismic reflection, down-hole logging, and bathymetric data collected by the GLOMAR CHALLENGER will also be available for distribution at the same time samples become available.

Requests for data may be made to:

Associate Chief Scientist,  
Science Services  
Deep Sea Drilling Project (A-031)  
Scripps Institution of  
Oceanography  
University of California  
at San Diego  
La Jolla, California 92093

A charge will be made to recover the expenses in excess of \$50.00 in filling individual requests. If required, estimated charges can be furnished before the request is processed.

#### 4. Reference Centers

As a separate and special category samples will be distributed for the purpose of establishing up to five reference centers where paleontologic materials will be available for reference and comparison purposes. The first of these reference centers has been approved at Basel, Switzerland.  
Revised 9/28/76

During Leg 47B the core catcher sample was split, described, and stored along with the rest of the core, if at all possible, taking care to maintain its proper vertical orientation. This sample represents the lowest stratum recovered in a particular cored interval.

The cored interval is the interval in meters below the sea floor measured from the point at which coring for a particular core was started to the point at which it was terminated. This interval is generally 9.5 meters (nominal length of a core barrel) but may be shorter if conditions dictate. The interval can also be longer if the core barrel was placed in the drill string during a long drilling interval. On Leg 47B almost all core intervals were 9.5 meters, because the drilling program called for nearly continuous coring.

When a core is brought aboard the *Glomar Challenger* it is labeled as to depth in meters below the sea floor.

#### Core Disturbance

Unconsolidated sediments are often quite disturbed by the rotary drilling/coring technique, and there is a complete gradation of disturbance style with increasing sediment induration. An assessment of degree and style of drilling deformation is made on board ship for all cored material, and shown graphically on the core description sheets. The following symbols are used:

- | Slightly deformed; bedding contacts slight bend.
- | Moderately deformed; bedding contacts have undergone extreme bowing.
- > Highly deformed; bedding completely disturbed, often showing symmetrical diapir-like structures.
- c Soupy, or drilling breccia; water-saturated intervals that have lost all aspects of original bedding and sediment cohesiveness.
- ✓ Void, interval in which no sediment occurs.

Consolidated sediments and rocks seldom show much internal deformation, but are usually broken by drilling into cylindrical pieces of varying length. There is frequently no indication if adjacent pieces in the core liner are actually contiguous or if intervening sediment has been lost during drilling.

#### Smear Slides

The lithologic classification of sediments is based on visual estimates of texture and composition in smear slides made on board ship.

These estimates are of areal abundances on the slide and may differ somewhat from the more accurate laboratory analyses of grain size, carbonate content, and mineralogy. Experience has shown that distinctive minor components can be accurately estimated ( $\pm 1$  or 2%), but that an accuracy of  $\pm 10\%$  for major constituents is rarely attained. Carbonate content is especially difficult to estimate in smear slides, as is the amount of clay present. Smear slide analyses at selected levels as well as averaged analyses for intervals of uniform lithology are given on the core description sheets. See Figure for explanation of smear slide notations. Visual estimates of sand, silt, and clay are given in addition to mineralogy.

#### Carbonate Data

During Leg 47B, extensive use was made of the "Karbonat Bombe" (Müller and Gastner, 1971) device as an aid in sediment classification. This device is basically a cylindrical vessel with pressure gauge in which a sediment sample of known weight is reacted with acid. The pressure of  $\text{CO}_2$  generated is measured and converted to percent carbonate. Accuracy to within  $\pm 5\%$  total carbonate has been quoted for the device. Shipboard carbonate bomb data are listed on the core description sheet.

Samples were taken for DSDP shore-based carbon-carbonate analysis using the LECO 70-second Analyzer (Boyce and Bode, 1972; Bode 1973). These and organic carbon values are tabulated following core forms (Table ). However, because shipboard core description sheets have been reproduced directly here, lithologic symbols depicting carbonate content graphically and sediment classifications based on smear slide descriptions have not been updated to reflect shore-based carbonate results.

#### Sediment Induration

The determination of induration is highly subjective, but field geologists have successfully made similar distinctions for many years. The criteria of Moberly and Heath (1971) are used for calcareous deposits; subjective estimate or behavior in core cutting is used for others.

##### a) Calcareous sediments

Soft: Oozes have little strength and are readily deformed under the finger or the broad blade of a spatula.

Firm: Chalks are partly indurated oozes; they are friable limestones that are readily deformed under the fingernail or the edge of a spatula blade.

Hard: Cemented rocks are termed limestones.

##### b) The following criteria are used for other sediments:

If the material is soft enough that the core can be split with a wire cutter, the sediment name only is used (e.g. silty clay; sand).

If the core must be cut on the band saw or diamond saw, the suffix "stone" is used (e.g. silty claystone; sandstone).

### Sediment Classification

The sediment classification scheme used on Leg 47B is basically that devised by the JOIDES Panel on Sedimentary Petrology and Physical Properties and adopted for use by the JOIDES Planning Committee in March, 1974, with minor modifications. The classification is outlined below.

- I        General rules for class limits and order of components in a sediment name.
  - A.      Sediment assumes the names of those components present only in quantities greater than 15%.
  - B.      Where more than one component is present, the component in greatest abundance is listed farthest to the right, and other components are listed progressively to the left in order of decreasing abundance.
  - C.      The class limits are based on percentage intervals given below for various sediment types.

#### II      Pelagic Clay

>10% authigenic components  
<30% siliceous microfossils  
<30% CaCO<sub>3</sub>  
<30% terrigenous components

#### III     Pelagic Siliceous Biogenic Sediments

>30% siliceous microfossils  
<30% CaCO<sub>3</sub>  
<30% terrigenous components (mud)

Radiolaria dominant: radiolarian ooze (or radiolarite).

Diatoms dominant: diatom ooze (or diatomite).

Sponge spicules dominant: sponge spicule ooze (or spiculite).

Where uncertain: siliceous (biogenic) ooze (or chert, porcellanite).

When containing 10-30% CaCO<sub>3</sub>: modified by nannofossil----, foraminiferal----, calcareous----, nannofossil-foraminiferal----, or foraminiferal-nannofossil----,

depending upon kind and quantity of  $\text{CaCO}_3$  component.

IV      Transitional Biogenic Siliceous Sediments

10-70% siliceous microfossils  
30-90% terrigenous components (mud)  
<30%  $\text{CaCO}_3$

If diatoms < mud:    diatomaceous mud (stone).  
If diatoms > mud:    muddy diatom ooze (muddy diatomite).  
If  $\text{CaCO}_3$  10-30%:    appropriate qualifier is used (see III).

V      Pelagic Biogenic Calcareous Sediments

>30%  $\text{CaCO}_3$   
<30% terrigenous components  
<30% siliceous microfossils

Principal components are nannofossils and foraminifera; qualifiers are used as follows:

<u>Foram %</u>	<u>Name</u>
<10	nannofossil ooze (chalk, limestone)
10-25	foraminiferal-nannofossil ooze
25-50	nannofossil-foraminiferal ooze
>50	foraminiferal ooze

Calcareous sediment, containing 10-30% siliceous fossils carry the qualifier radiolarian, diatomaceous or siliceous depending upon the identification.

VI      Transitional Biogenic Calcareous Sediments

>30%  $\text{CaCO}_3$   
>30% terrigenous components  
<30% siliceous microfossils

If  $\text{CaCO}_3$  30-60%:    marly is used as a qualifier:

Soft:    calcareous (or nannofossil, etc.) ooze.  
Firm:    chalk (or nannofossil chalk, etc.).  
Hard:    limestone (or nannofossil limestone, etc.).

If  $\text{CaCO}_3$  >60%:

Soft:    calcareous (or nannofossil, etc.) ooze.  
Firm:    chalk (or nannofossil chalk, etc.).  
Hard:    limestone (or nannofossil limestone, etc.).

NOTE: Sediments containing 10-30% CaCO<sub>3</sub> fall in other classes where they are denoted with the adjective "calcareous", "nannofossil", etc.

## VII Terrigenous Sediments

>30% terrigenous components  
<30% CaCO<sub>3</sub>  
<10% siliceous microfossils  
<10% authigenic components

Sediments in this category are subdivided into textural groups on the basis of the relative proportions of three grain-size components, i.e. sand, silt and clay. Sediments coarser than sand-size are treated as "Special Rock Types". The size limits are those defined by Wentworth (1922). The textural classification is according to the triangular diagram of Shepard (1954) (Figure ). The suffix "-stone" is used to indicate hard or consolidated equivalents of the unconsolidated sediments.

If CaCO<sub>3</sub> is 10-30%: calcareous, nannofossil, etc. is used as a qualifier.

Other qualifiers (e.g. feldspathic, glauconitic, etc.) are used for components >10%.

## VIII Volcanogenic Sediments

- a) Pyroclastic rocks are described according to the textural and compositional scheme of Wentworth and Williams (1932). The textural groups are:

Volcanic breccia >32 mm  
Volcanic lapilli <32 mm  
Volcanic ash (tuff, if infurated) <4 mm

Compositionally, these pyroclastic rocks are described as vitric (glass), crystal or lithic.

- b) Clastic sediments of volcanic provenance are described in the same fashion as the terrigenous sediments, noting the dominant composition of the volcanic grains where possible.

### Lithologic Symbols

Figure 4 shows the graphic symbols used to depict the lithologies encountered on Leg 47B. In addition, many symbols are referenced on core sheets in which they occur.

	VOID		SLUMPED & CONTORTED NANNO CHALK [D-15]
	CLAY (terrigenous)		PEBBLES (rounded) VARIOUS LITHOLOGIES [D-27]
	NANNO OOZE		ZEOLITE
	SAND LENSE		DOLOMITE
	CARBONATE OOZE (micritic unspecified)		CLASTS IN CONGLOMERATE
	FORAM-NANNO OOZE		PYRITE [D-136]
	BALLS OR CLASTS WITHIN MATRIX (probably drilling disturbance)		DOLOMITE LENSE [D-77]
	SILICEOUS OOZE		SHELL FRAGMENT (molluscan)
	RADIOLARIAN OOZE		GRADED BEDDING [D-100]
	SILT		INTERSTITIAL WATER SAMPLE
	SAND		ORGANIC GEOCHEMISTRY SAMPLE
	NANNO CHALK [D-15]		

FIGURE 4. LITHOLOGY

### Color

Color determinations are based on standard Munsell and GSA color charts.

### Core Forms

Leg 47B (Site 398, A, B, C, D) core forms in this book are reproduced directly from core forms prepared on board ship due to time considerations and the complex nature of lithologies in this passive margin setting. A certain amount of uniformity was maintained in preparing these forms in accordance with standard symbols used by the DSDP; however, a number of nonstandard symbols were used which denote a variety of color changes, sediment textures, and components not common to deep sea sediments. Some changes in systematics of core description were made at certain major lithologic transitions and were dependent on the sedimentologist responsible for forms at the time. All symbols and conventions utilized are explained on the core forms. For convenience, a listing is provided in Figure 5. Each symbol is accompanied by an explanation. The numerals next to each one represent the first core numbers in which the symbol is used (e.g. D-18 indicates core number 398D-18, etc.). After 398D-9, the "deformation column" was used to denote numerous color changes characterizing a rhythmically bedded sequence. Symbols are explained on each core sheet (see Figure 6) by drilling operations. Deformation of core materials became relatively unimportant after 398D-9. This column becomes more of a facies indicator incorporating both color and sedimentary structures after 398D-56. Again, symbols are explained on core forms as they occur.

A sedimentary structure column was also added to graphically depict notable structures and extent of bioturbation. All symbols are shown in Figure 7.

An overall view of conventions used on the core forms is shown on Figure 6.

### Biostratigraphy

Biostratigraphic studies of Leg 47B material were still in progress when Leg 47B Initial Core Descriptions were compiled. Consequently biostratigraphic boundaries cited here are tentative; some boundaries may be adjusted prior to publication of Leg 47B Initial Reports. The Albian-Aptian boundary has been changed. Based on Ammonite data it is placed at 1370 meters in C.99.

COLOR KEY - SYMBOLS  
CRETACEOUS

D-56	 	dk. gy. to blk. organic C-rich layers.	 	interstitial water
		5Y 6/1-5GY 8/1	D-77	 dolomite lense
D-57		5GY 4/1		 shell fragment
		N-3, N-4		 graded bedding
		N-2, N-3      5GY 2/1	(1) burrowed	 clasts in conglomerates
D-63		N-2, N-3      5GY 2/1	(2) laminated	D-136  pyrite
		N-3              5GY 2/1	(3) laminated-dolomitic	
		1 & 2 mixed		
		(a) 5G 3/1		
D-67		(b) N-3		
		(c) N-3, 5GY 6/1		
		(a) 5GY 2/1	homog., burrowed	
D-68		(b) N-1, N-2	homog. → lamin.	
		(c) N-2, 5Y 2/1	dolomitic, banded	
		(d) N-4, 5Y 4/1	laminated	
D-120	1, 2, 3 in litho. sample column refers to major sedimentary units defined in description.			

FIGURE 5. CORES 398D-56 → 138

398A-1 SED. ST. COLUMN       layers of 5GY 6/1 grn. gy.       lt. gy.

398D-3

 dker. 5GY 8/1 as noted  
dashed line is gradational change to  
full line is sharp contact

N-9

D-4 5B 8/1

D-5 5B 7/1

D-15 5GY 6/1-5G 6/1

 5B 7/1

 xxxxx lamination of rapid rhythmic color changes

D-25 2.5Y 5/2

 10YR 5/3-6/3

D-27 5G 7/1

 10YR 6/3

D-28 5G 6/1

D-36 5G 7/2, 7/1, N-7

 10YR 6/3

D-37 5B 7/1

 10YR 7/3-5/3

D-38 5GY 7/2-5/2      10GY 5/2

 10YR 7/3-5/3      5YR 4/4

D-39 5Y 7/2      5Y 8/1

 10YR 5/4-6/6

D-50 5B 7/1

 5YR 3/4; 7.5YR 5/4

FIGURE 5. (CONTINUED)

FIGURE 6. SAMPLE CORE DESCRIPTION

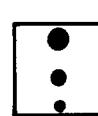
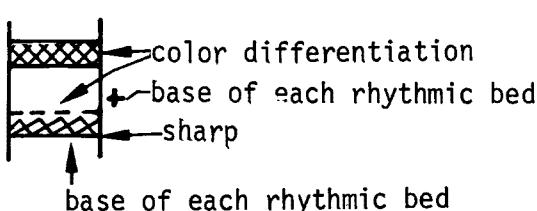
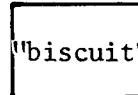
	Burrow		Thinly-laminated parallel lamination
	Parallel lamination		Cross-bedded sets
	Deformed lamination		Pebble to granule conglomerate
	Bioturbation		Sedimentary microfaults [D-22]
	Diagenetic laminae (grn., Liesegang-type band) [D-3].		Graded bedding [D-22]
	Flaser lamination (wavy) [D-3]		Reverse grading [D-23]
	Micro-cross lamination		Fault (not drilled) [D-24]
	Sharp, burrowed, irregular contact.		Flame structure [D-24]
	color differentiation base of each rhythmic bed sharp base of each rhythmic bed		Micro-cross lamination ripples [D-32]
	Possible contourites - laminated to cross-laminated chalks.		Biscuit texture (drilling deformation) [D-51]
	Slumped & contorted lamination [D-15]		

FIGURE 7. SEDIMENTARY STRUCTURES



### Explanatory notes in chapter 1

Site 398 Hole 3 Core 3 Cored Interval: 17.5 - 27.0

AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHOLOGIC DESCRIPTION	
		Foram.	Nanno					LITHO. SAMPLE	SED. STRUCT.
Pleistocene	N 10-20 Dismaster brouweri - Pseudocardinalia locusta nov 19/9	A9	A9	1	0.5 1.0	GY 8/1 (lt. grn. gray) NANNO Ooze & w/ some SY7/2 (yellowish gray) MARLY NANNO Ooze alternations w/darker lt. ol. gray (SY5/2) organic and pyrite-rich irregular laminae. Core disturbed w/ mud balls or clasts of SY5/2 (lt olive gray)	< ✓ ✓	-23	
		A9	A9	2				-51	
		A9	A9	3				-102	
		A9	A9	4				-56	
		A9	A9	5				-84 -98 -128	dark gray to blk. mud nodules or clasts in matrix of NANNO Ooze FORAM-NANNO Ooze SY8/1 to SY8/1 (lt. grn. gray) MARLY NANNO Ooze SY7/1 (lt. yel. gray) NANNO Ooze intensely bioturbated, chondrites, Mycetilia, organic 5Y8/1 to 5Y8/1 (lt. grn. gray) NANNO Ooze bioturbation slight
		A9	A9	6					intensely bioturbated mottled
		A9	A9	Core Catcher					

SMEAR (1-23) [5,20,75]  
 50% nannos  
 29% clay  
 5% qtz.  
 5% pyrite  
 5% carb.unspec.  
 3% forams  
 2% silic.unspec.  
 1% mica

SMEAR (2-51) [5,5,90]  
 75% nannos  
 18% clay  
 3% pyrite  
 2% dolomite  
 1% quartz  
 1% fecal pellets

SMEAR (3-102) [5,5,90]  
 70% nannos  
 18% clay  
 5% forams  
 3% carb.unspec.  
 2% dolomite  
 2% pyrite  
 tr. quartz, mica, heavy min.

SMEAR (4-56) [15,20,65]  
 55% nannos  
 20% clay  
 15% forams  
 4% carb.unspec.  
 1% dolomite  
 1% quartz  
 1% mica  
 tr. glauconite, pyrite,  
 2% fecal pellets.

SMEAR (4-84) [5,15,80]  
 70% nannos  
 20% clay  
 5% forams  
 3% carb.unspec.  
 1% glauconite  
 1% quartz  
 tr. pyrite, mica

SMEAR (4-128) [5,35,60]  
 40% nannos  
 32% clay  
 3% silic.unspec.  
 15% qtz.  
 2% mica  
 2% dolomite  
 2% pyrite  
 1% heavy mins

SMEAR (4-128) [3,15,82]  
 65% nannos  
 15% clay  
 5% forams  
 5% fecal pellets  
 5% carb.unspec.  
 2% qtz.  
 1% mica  
 1% magnetite  
 1% org.matter  
 tr. glauconite, dolomite,  
 pyrite





AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION		
		FORAM	NANNO									
										[SHEAR] (57) [4, 6, 90]	65% nannos 29% clay 2% forams 2% carb unspc. 1% dolomite 1% quartz tr. heavy mns, glauconite, pyrite, sponge sp.s.	
C3 -	C9 -			1	0.5	S		57			bluish white SB & l alternating with white N9, usually with sharp contacts, varying thicknesses of each, 5-50cm at top of core, increasing to 20-100cm [SHEAR] (59) [4, 10, 86]	
C3 -	A9 -			2	1.0						65% nannos 26% clay 5% pyrite (± pyritic, ± organic ??) 2% forams 2% fecal/pellets 1% carb unspc. 1% dolomite tr. qtz, heavy mns, sponge spics.	
C3 -	C9 -			3	0.5						[SHEAR] (2-60) [5, 10, 85]	65% nannos 28% clay 4% forams 1% carb unspc. 1% pyrite 1% qtz tr. mica, heavy mns, glauconite,
C3 -	C9 -			4	1.0						[SHEAR] (4-128) [3, 10, 87]	65% nannos 25% clay 5% forams 2% pyrite 2% fecal/pellets 1% qtz tr. heavy mns
RF -	A9 -			5	0.5						[SHEAR] (5-103) [0, 8, 92]	80% nannos 16% clay 2% pyrite 1% dolomite 1% qtz tr. mica, heavy mns, forams
RF -	A9 -			6	0.5						[SHEAR] (6-2) [2, 10, 85]	75% nannos 17% clay 2% qtz 2% pyrite 2% forams 1% heavy mns 1% carb unspc. tr. mica
CF -	C9 -										[SHEAR] (6-34) [5, 8, 87]	70% nannos 15% clay 5% forams 2% qtz 2% pyrite 1% dolomite 1% carb unspc. 1% heavy mns 3% fecal/pellets tr. mica
						Core Catcher						

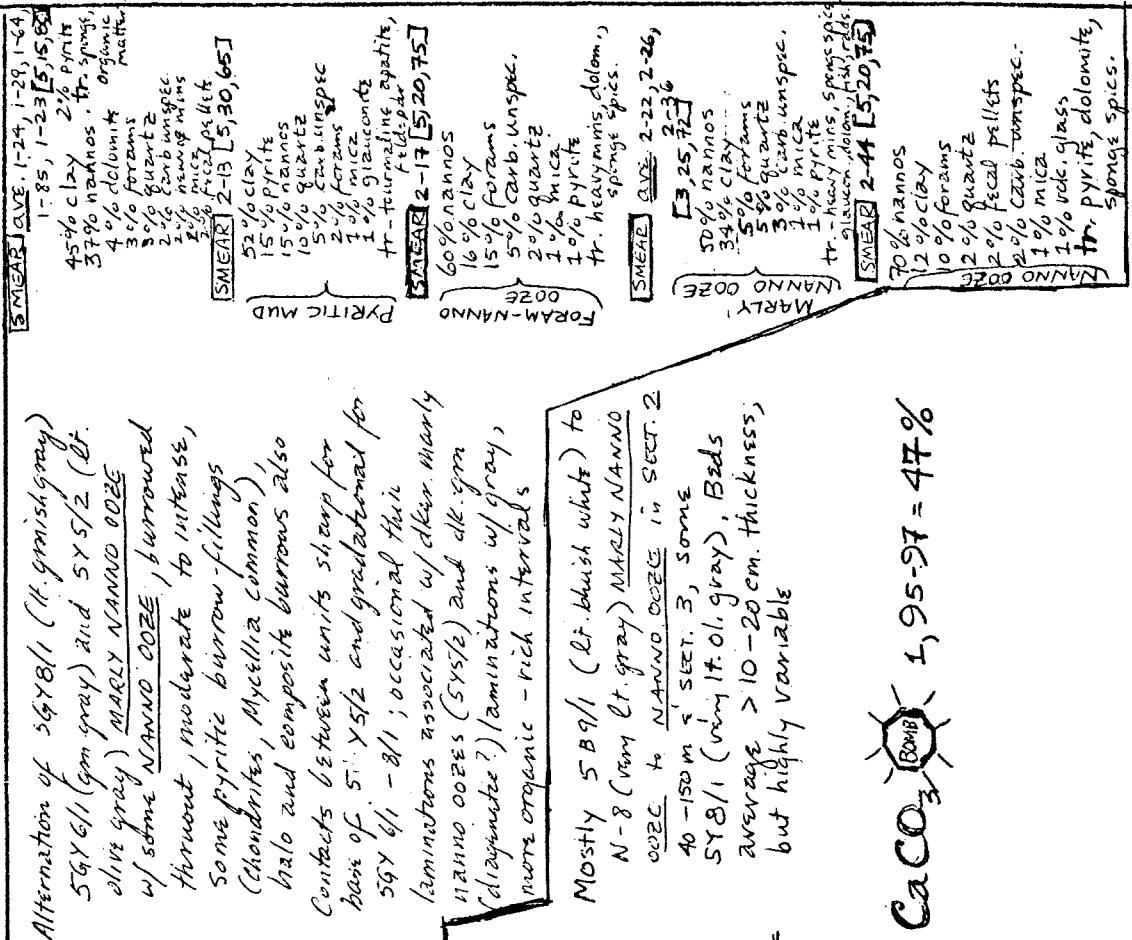
Site 398	Hole C	Core 1-CC Cored Interval: 0-79.0m	LITHOLOGIC DESCRIPTION			
			FOSIL CHARACTER	LITHOLOGY	METERS	SED. STRUCT.
					0.5	CLAY CATCHER ONLY - UNDRIENTED
					1	NARLY NANNI 202E
					1.0	BLuish white to light bluish gray 587/1+589/1 laminated with purplish gray organic streaks greenish gray 581/6/1 organic streaks & mottles
					1.0	47% clay 45% nannos 4% f/g 2% forams 1% carb unspc. 1% mica tr. heavy mineral, pelagic volc. glass, dolomite
					2	Core Catcher
						-19
			ZONE			NN 19/20
			AGE			Plagiostrophe

site 398 Hole D Core 1 Cored Interval: 0-9.5

AGE	ZONE	FORAM.	FOSIL CHARACTER	SECTION METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
				0.5 1	1.0			<u>No RECOVERY</u>

Site 398 Hole D Core 2 Coring Interval: 271.0-280.5

SED. STRUCT						
LITHO. SAMPLE						
DEFORMATION						
LITHOLOGY						
METERS	0.5	1	1.0	2	3	Core Catcher
SECTION	1			2		
FOSIL CHARACTER						
ANIMAL						
FORM	Ae	Ae	Ab	Ab	Cg	Cg
ZONE	Cerafolithus tricarinicalatus - NW12 N 19-20				cp - cg	
AGE	PLIO CENE					
EARLY						

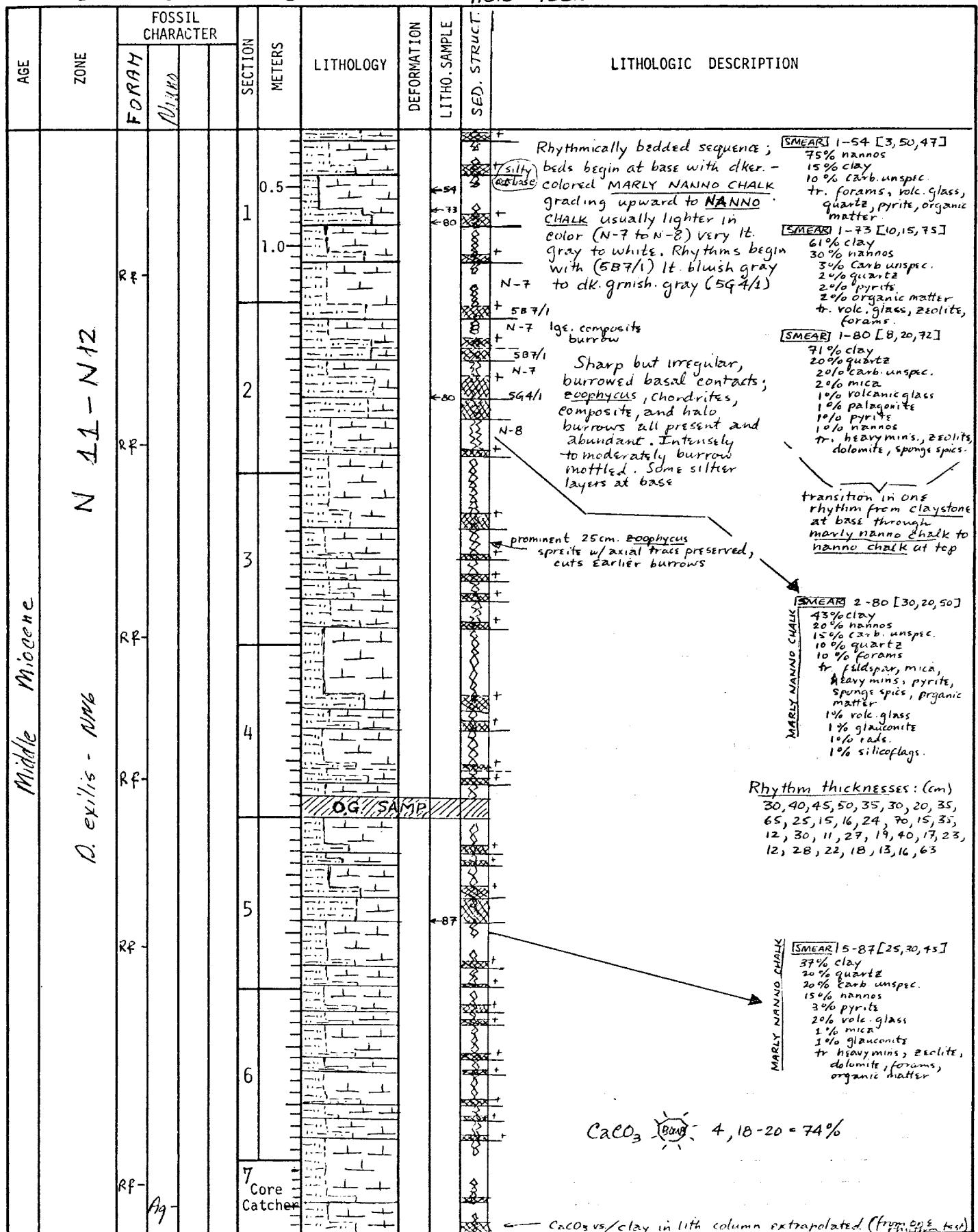


AGE	ZONE	FORAM	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCT.	LITHOLOGIC DESCRIPTION	
										[SPECIAL SYMBOLS]	
Late Miocene	N 17	RF	Nanno							* dk. grn. diagnostic laminate ** sharp, burrowed, irreg. contact 3XXXX+ denotes gradation from darker-colored bottom parts of rhythmic beds, to lighter-colored pelagic part	
		CP			0.5					BETTER LITHIFIED → CHALKY	[SMEAR] 2-55 [1, 20, 79]
		RP		1	1.0					Rhythmic Sequence of beds with sharp, but burrowed basal contacts, generally a color and CaCO <sub>3</sub> content gradation from base to top. 5GY8/1 (lt. greenish gray) at base becoming lighter upward to 589/1 (lt. bluish white) and N-9 (white), less calcareous (more clay-rich) at base. Intensely burrowed throughout, common unidentifiable mottles and halo burrows, also zoophycus, echinoids, and numerous composite burrows.	65% nannos 23% clay 5% quartz 3% forams 3% carb.unspec. 1% dolomite tr. pyrite, zeolites, mica, organic matter
		RP		2							[PYRITIC BURROW]
		RR		3							[SMEAR] 3-102 [0, 10, 90]
						O-G SAMPL.				80% pyrite 10% nannos 5% clay 3% quartz 2% carb.unspec. tr. mica	
				4						Diagenetic laminations present in association with more organic rich mottles or intervals, usually above. approx 5mm outward from organic layer. Laminae <1mm thick	
		RF		5							[SMEAR] 6-31 [3, 15, 82]
				6						58% clay 30% nannos 4% quartz 3% dolomite 2% carb.unspec. 2% heavy mins. tr. mica, glauconite, forams, sponge spic.	
				7						1% pellets	
		RF	A <sub>7</sub>	Core Catcher						[SMEAR] 6-50 [2, 8, 90]	
										50% clay 40% nannos 3% quartz 2% heavy mins. 2% carb.unspec. 2% dolomite 1% pellets tr. mica, pyrite, forams	
										[SMEAR] 6-59 [3, 15, 82]	
										44% clay 40% nannos 5% quartz 3% dolomite 2% heavy mins. 2% carb.unspec. 1% mica 1% pyrite 2% pellets tr. glauconite	
										[SMEAR] 7-42 [0, 5, 95]	
										50% nannos 42% clay 3% quartz 3% carb.unspec. 2% forams tr. mica, tourmaline, organic matter, fish remains, dolomite	

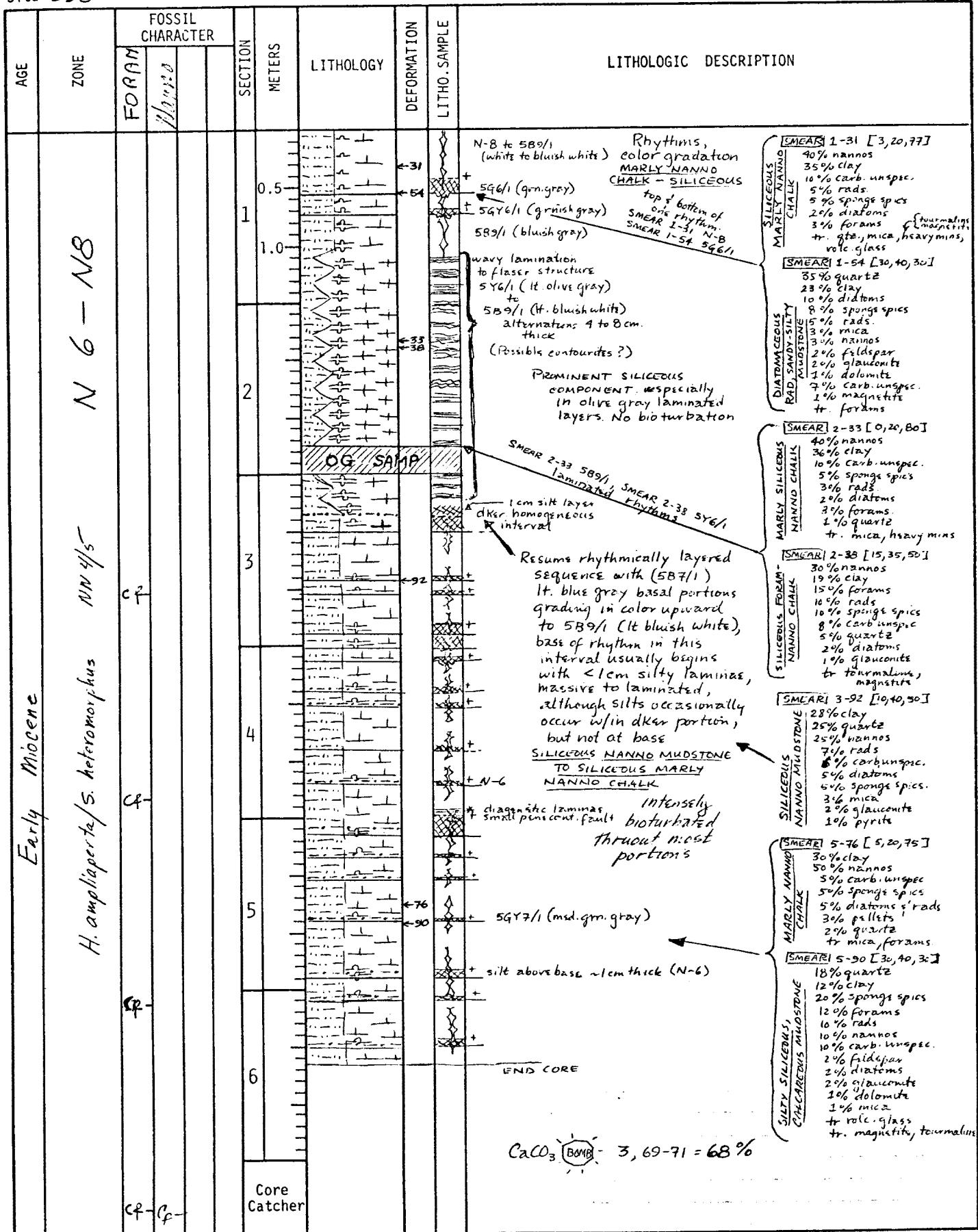


### **Explanatory notes in chapter 1**

\* irregular, sharp contact







Explanatory notes in chapter 1

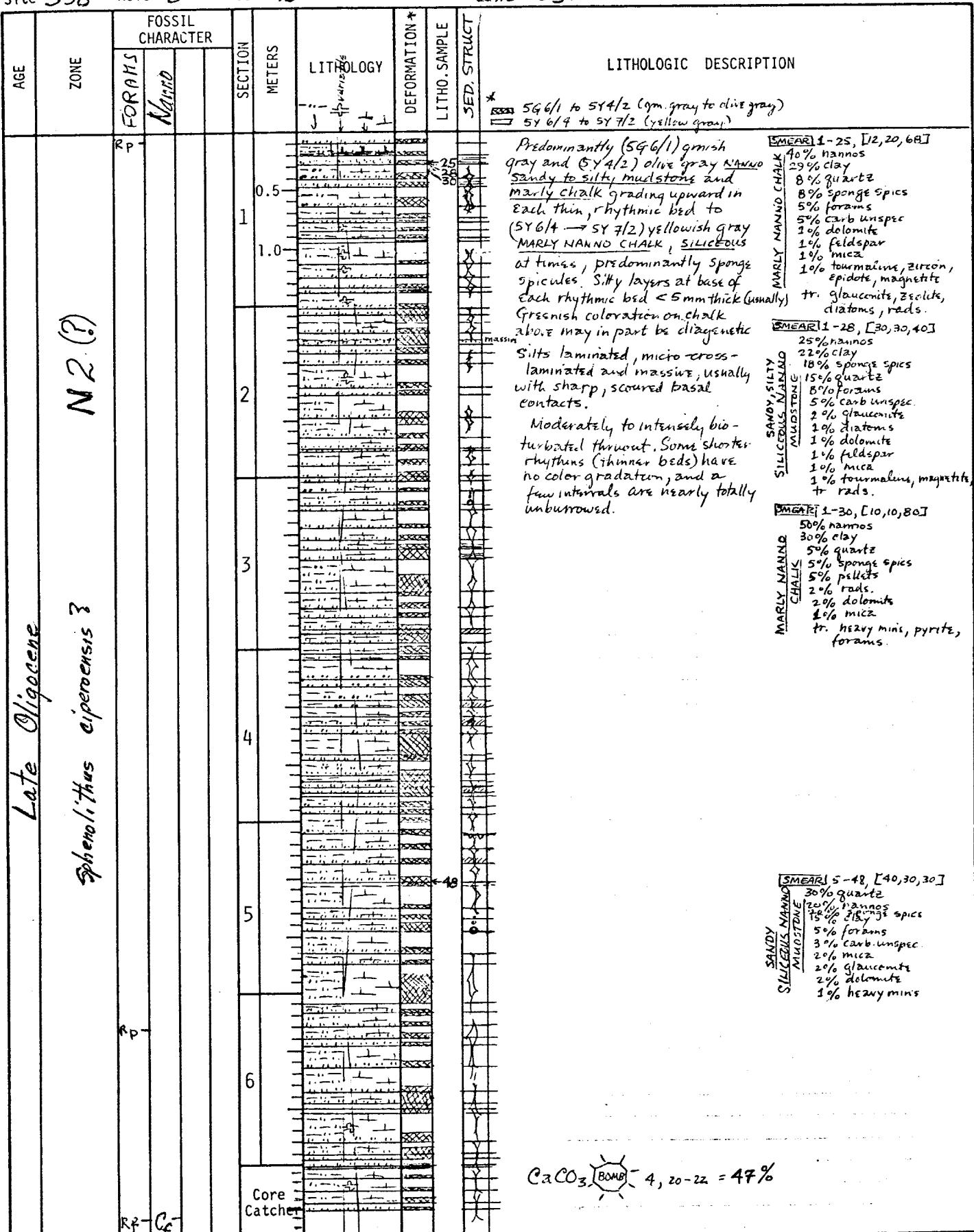
AGE	ZONE	FOSSIL CHARACTER		LITHOLOGIC DESCRIPTION					
		FORAM	NANNO	SECTION	METERS	LITHOLOGY	* DEFORMATION	LITHO. SAMPLE	SED. STRUCT.
<i>* AVE SHOWN, Clay content Calcareous variable</i>									
Early Miocene	Late Oligocene - Early Miocene	CR			0.5			← 11	
<i>Rhythmically bedded SEQUENCE OF SILICEOUS NANNO MUDSTONE (5G 6/1 to 5G Y 6/1) grayish tan to SILICEOUS NANNO MUDSTONE to MARLY NANNO CHALK (5B 9/1 to N-9) white to bluish white (each rhythm from lower Calcareous content at base to higher in finer grained interval - lighter colored at top).</i>									
<i>Many rhythms begin with current deposited silty base up to 2 cm thick as noted in sed. struct. column, silts to f.g. sands commonly laminated to cross-laminated, with erosional lower contacts</i>									
<i>Intensely bioturbated throughout with predominance of <i>Zoophycus</i>, some <i>Lycellina</i>, <i>Holminicula</i>, intense mottling. Burrowing seems especially concentrated near base of rhythmic beds - due possibly to visibility because of lithologic contrast or to availability of organic matter in redeposited beds.</i>									
<i>CaCO<sub>3</sub> BOMB = 2,93-95 = 58%</i>									
RF	Cf			1	1.0			← 23	
<i>SILICEOUS, CALCAREOUS NANNO MUDSTONE</i>									
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<i>SILICEOUS, CALCAREOUS NANNO MUDSTONE</i>									

Site: 398 Hole D Core 10 Cored Interval: 489.5 - 499.0

AGE	FORAM	MICROFAUNA	FREQUENTLY ABSENT	LITHOLOGIC DESCRIPTION							
				ZONES	Fossil Character	METERS	SECTION	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES
	TP	TP	TP					SG 6/1 (grainy gray) NANNO CHALK			

Site 398 Hole D		Core 11 Cored Interval: 499.0 - 508.5		Lithologic Description
Age	Zone	Section	Meters	Lithology
Fossil Character				
			0.5	SED. STRUCTURES
			1	LITHO. SAMPLE
			1.0	DEFORMATION
				NO RECOVERY







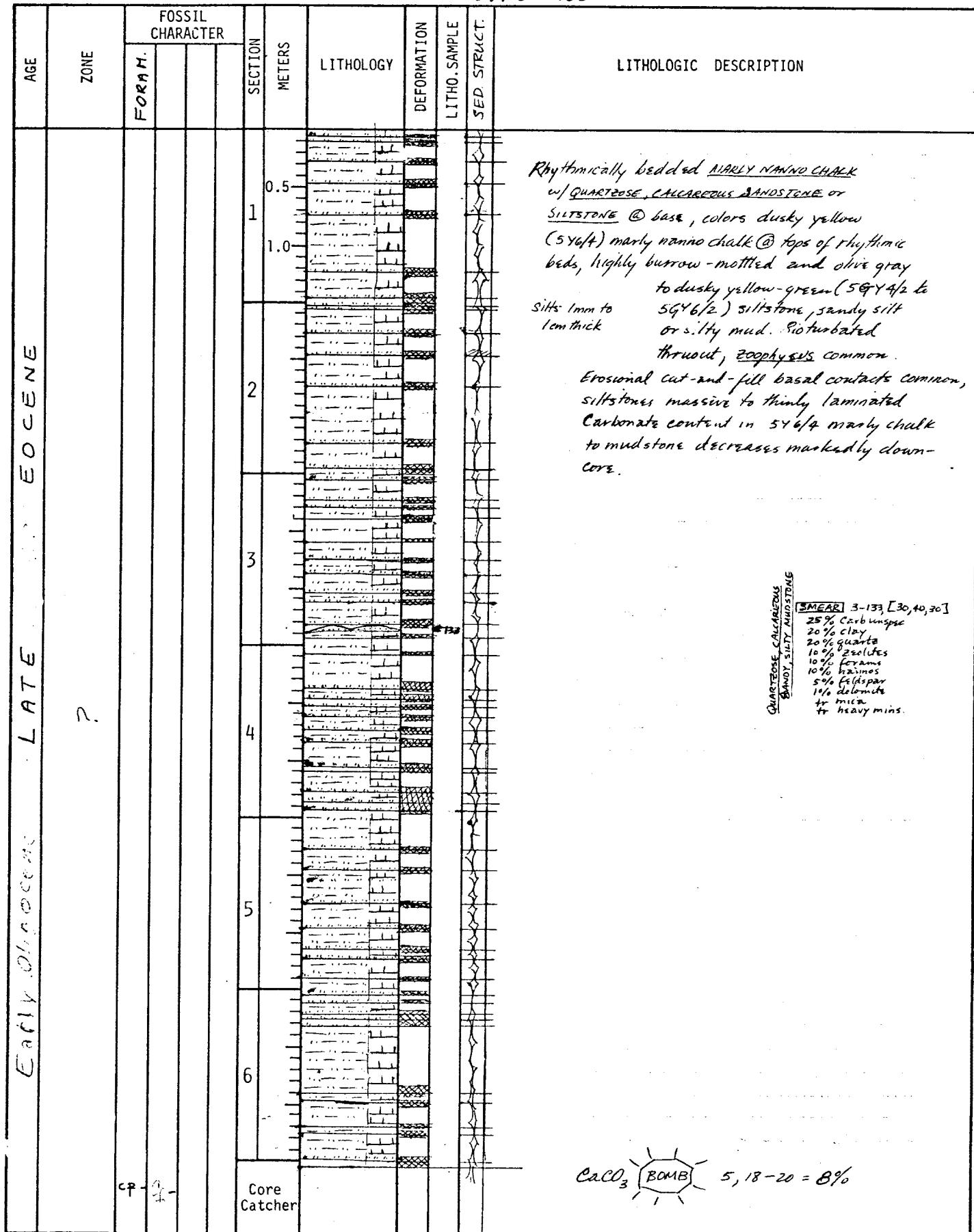


Site	Hole	Core	Core Interval:	Lithology	Description
Zones	Fossil Character	Form	Meters	Section	Lithology
	Nanno	Rp-Cf			Sed. Structures
398	D	Core 16	556.0 - 565.5 m	Greenish gray (SG-7/1) marly nanno chalk burrowed 1 cm of hard sandy mudstone at base 20 cm long	LITHO. SAMPLE
					DEFORMATION
					SEED STRUCTURES

Site 398 Hole D Core 17 Cored Interval: 565.5- 575.0 m

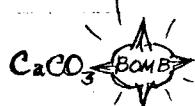
AGE	ZONE	FORAM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION
MIDDLE Oligocene	Sphaerolithus predistinctus - NP23	Tp-Cf	1	0.5-1.0	Siliciclastics	Core Catcher	-10	Siliceous Marly Nanno Chalk yellowish olive (547/2, 546/2) laminated - parallel and thin irregular, wavy folded (?) similar to interval below 59 cm in core 15	Smear (1-10) [7, 13, 80] 50% nannos. 24% clay 5% fecal pellets 5% carb unspec. 2% dolomite 2% quartz. 10% sponge spics. 1% mica 1% heavy min. fr. forams





## Explanatory notes in chapter 1

AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO SAMPLE	SED. STRUCT	LITHOLOGIC DESCRIPTION	
		FORAM	FAUNA								
LATE EOCENE	?			1	0.5					Succession of silt - marl Rhythms continues throughout core, base of bed w/ thin (1mm to 2 cm) silty or sandy layer of SG6/1 greenish gray grading in color to SY5/2 and 10 YR 6/2 mod. yel. brown.	[SMEAR] 1-43, [20, 25, 55] 32% clay 15% quartz 10% mica (>10% chlorite?) 10% sponge spics 5% rads 2% zoolites 1% org. matter tr. nannos tr. carb. unspac. tr. pyrite
				1	1.0					SILICEOUS MARLSTONE and MARLY CHALK, silts occasionally SB7/1 lt. bluish gray.	[SMEAR] 1-69, [75, 50, 25] 25% nannos 20% quartz 19% clay 15% carb. unspac. 15% chlorite - mica? 5% sponge spics tr. feldspar tr. heavy min. tr. pyrite 2% zoolites tr. rads tr. organic matter
				2						Bioturbated threduct	
				3						cut-and-fill, lamination in silty-sand layers.	
				4						colors becoming darker in "semi-pelagic" intervals	[SMEAR] 1-90, [5, 35, 60] 44% clay 25% nannos 10% carb. unspac. 10-15% mica (>chlorite?) 5% quartz 5% sponge spics 1% organics tr. zoolites tr. rads
				4	90					microfossils in laminae below	[SMEAR] 4-104, [10, 50, 40] 30% carb. unspac. 29% clay 25% nannos 10% sponge spics 2% quartz 2% chlorite (?) 2% organic debris tr. forams, dolomitic, zoolite, glass (?), heavy min.
				4	104					10 YR 9/2 - 5/4 (mod. to dk. yel. brown.)	[SMEAR] 4-108, [30, 50, 20] 25% carb. unspac. 20% nannos 20% sponge spics 10% quartz 12% clay 7% mica (chlorite?) 5% rads 1% organic debris tr. zoolite, forams, diatom
				5						10 YR 4/2 (dk. yellowish brown.)	
				5						← 10 YR 5/4 (mod. yellowish brown)	
				5						← 10 YR 7/4 (grayish orange)	
				5						← SB7/0 (mod. bluish gray)	
				5						← 10 YR 5/4 (mod. yel. brown.)	
				6						THE END	
				Core Catcher							
		RP - Rf -									



5, 88-90 = 14%

LAURENT MINDLIN EDITION

DISCUSSIONS ON THE NATURE OF P 16

398 Hole B Core 23 Cored Interval: 622.5 - 632.0

chapter 1



Site 398	Hole D	Core 25	Cored Interval: 641.5 - 651.0
AGE	MIDDLE EOCENE		
ZONE	D'Esca'ster faunal nomenclature - NIP/16		
FOSSIL CHARACTER	FORAM	SECTION	LITHOLOGY
METERS	0.5	1	Rhythmically bedded as before, begins w/ N-6, N-7 Et gray silt and silty mudst. grading up to 2.5 y Et2 Radiolarian MUDSTONE and SILICEOUS MAREY NANNO CHALK and some CHALK
DEFORMATION	83	1.0	Burrowed thoracic, composite burrows, zoophytes
LITHO. SAMPLE		THE END	
SED. STRUCT.			
Core Catcher			
RE-CF			
<p style="text-align: center;">LITHOLOGIC DESCRIPTION</p> <p>25 yr 6/2, Et brownish-gray "monoplagic" 25 yr 6/2, SYR 4/4, N-6 to N-7 gray to gray-brown shades.</p> <p>1-73 [3, 30, 67] = 5-7% Et/2 (illite) 10% quartz 10% radiolarians 10% sponge spics 3% dolomite 3% carb. unsp. 3% nanno 2% dolomite 2% mica to heavy mins</p> <p>1-83 [10, 40, 50] = 30% nanno 15% sponge spics 11% clay 10% mica 10% quartz 5% carb. unsp. 5% forams 5% radi. 20% fieldspar 2% calcites 2% dolomites 1% dolomites 1% dolomites 1% heavy mins 1% granule 4% glass</p> <p><i>CaCO<sub>3</sub> (Bound) 1, 46-48 = 10%</i></p>			

AGE	ZONE	FORAM	FOSSIL CHARACTER	LITHOLOGIC DESCRIPTION				
				SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE EOCENE	Chilogena lithus asstra. N/P 15	RP-		1	0.5	SILICEOUS		
				2	1.0	SILICEOUS		
				3		SILICEOUS		
				4		SILICEOUS		
				5		SILICEOUS		
				6		SILICEOUS		
		Core Catcher						
SILICEOUS, MARLY CHALK								
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site 398

Hole D

Core 27

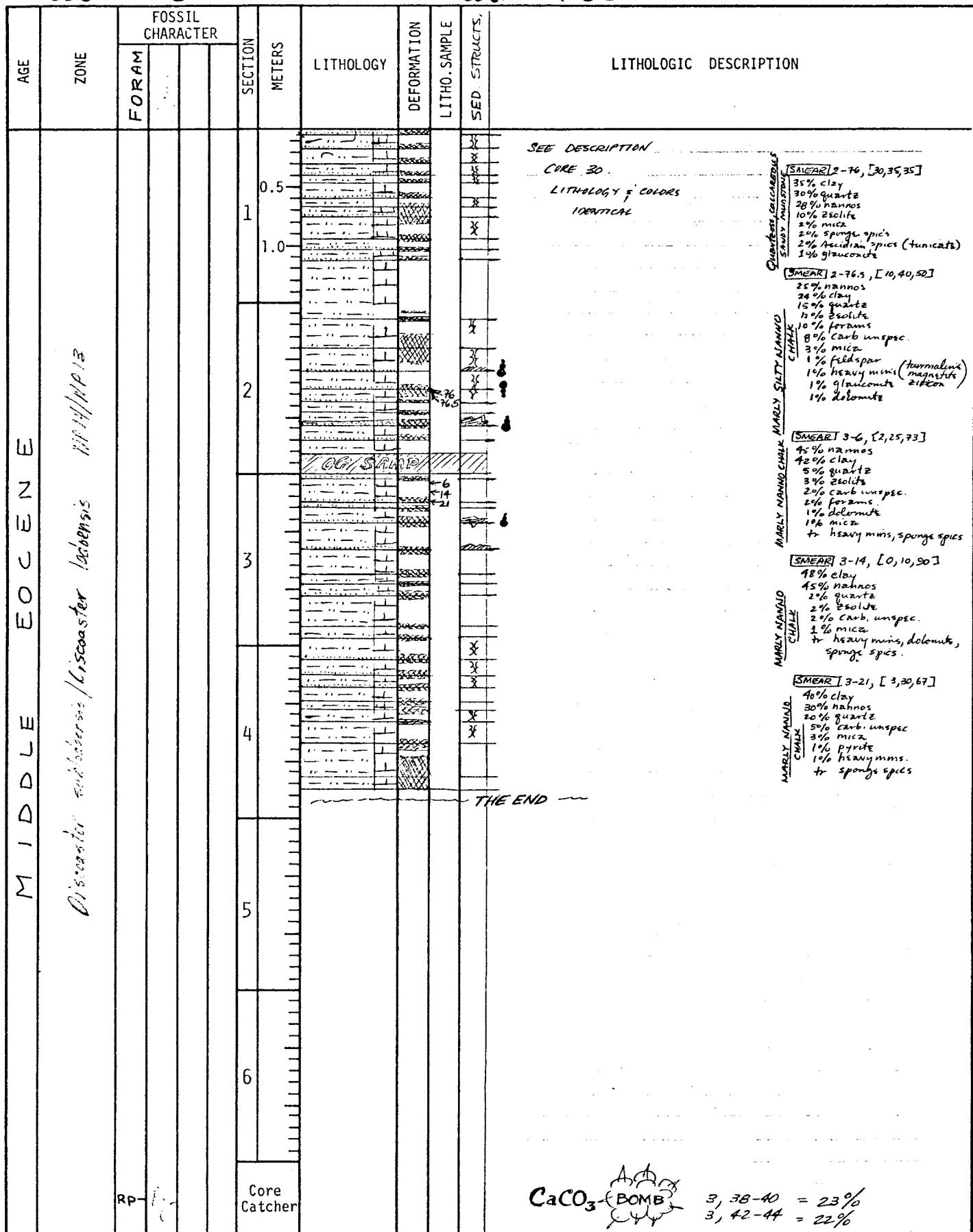
Cored Interval: 660.5-670.0 m

### Explanatory notes in Chapter 1

AGE	ZONE	FOSSIL CHARACTER	FORAM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION	
									ED. STRUCTURES	
MIDDLE EOCENE	Dicroidium Subbiostratum / Dicroidium Substratum	10/14 / 10/15	RP-1	1	0.5	0.5	←65	core	Continue rhythmic sedimentation from Core 28 10YR 5/3 - 6/3 ① top rhythm in MARLY NANNO CHALK to QUARTZOSE MUDSTONE decrease in siliceous fossil component, base most rhythms are 5G 6/F grayish gray siltst. to sandstone possible slumped debris flow, no large distinctive clasts.	
				2	1.0	1.0	X		Bioturbation less apparent in this core, intense in some portions, rare in SECTS. 1 & 6. zoophores and other unidentifiable molluscs	
				3	1.5	1.5	X		MARLY NANNO CHALK 35% nanos 34% clay 21% dolomite 10% calcite 5% quartz 5% carbonates 5% sponge spics 2% mica 1% diatoms + to heavy minis	
				4	2.0	2.0	X		MARLY NANNO CHALK 30% clay 30% dolomite 20% nanos 7% sponge spics 3% mica 1% heavy minis 1% glauconite 1% calcite to forams	
				5	2.5	2.5	X		QUARTZOSE MUDSTONE 30% clay 30% dolomite 20% nanos 8% sponge spics 5-6 pellets 2% mica 2% dolomite 2% glauconite 1% calcite	
				6	3.0	3.0	X		QUARTZOSE MUDSTONE 40% quartz 20% nanos 17% clay 7% sponge spics 3% dolomite 2% mica 2% heavy minis 2% glauconite 2% calcite 3% carbonates 2% dolomite	
				7	3.5	3.5	X		SILTY 45% clay 33% quartz 8% sponge spics 5% nanos 5% dolomite 1% calcite 1% heavy minis	
					4.0	4.0	X		Caco <sub>3</sub> BOMB 3, 57-59 = 38%	
					4.5	4.5	X		THE END	

AGE	ZONE	Fossil Character	FORAM Name?	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
MIDDLE EOCENE	Pisaster subhirsutus/Chonetes lateralis	NP 14; 15/19								5G 6/1, 6/1, 7/1 (gnish gray) 10YR 6/3 - 5/3 (pale brown)	
										Continuation of rhythmic sequence of cores 19-29, same colors as core 29 (5G 6/1, 6/2, 7/1) gnish gray sandstone w/ siltstone laminas at base of each bed grading into MARLY NANNO CHALK or CALCAREOUS MUDSTONE of 10YR 6/3 - 5/3, pale brown w/ some variegation or mottling of 5G 6/1. Quartz an important component in all sediments, especially coarser-grained basal intervals. Biosturbation generally moderate to intense, some intervals unbioturbated, especially at base of rhythms.	
				1	0.5					Occasionally a rhythm lacks basal sand-silt; sandy or silty intervals usually <3 cm thick, typically 25 mm laminae, graded- bedding occurs but not predominant, lamination & micro-cross lamination common.	
				2	1.0					SMEAR 3-91 [0,20,80] 83% clays 15% nanno 10% carb. unspec 10% calcites 5% quartz 5% mica 2% dolomite to heavy mms, sponge spic.	
				3	1.5					SMEAR 3-16 [40,30,30] 35% nanno 30% quartz 20% clay 3% mica 2% heavy mms 2% dolomite 1% carb. unspec to sponge spic.	
				4	2.0					SMEAR 3-97 [25,50,25] 50% quartz 12% clay 12% calcite 5% feldspar 5% mica 3% carb. unspec 8% nanno 2% forams 1% tourmaline, magnetite 1% glaucocrite 1% dolomite	
				5	2.5					SMEAR 3-100 [10,50,40] 40% nanno 35% clay 20% quartz 3% mica 3% spongopelitic 3% heavy mms	
				6	3.0					THE END	
										$\text{CaCO}_3 \text{ BOMB } 2,85-87 = 45\%$	
						Core Catcher					

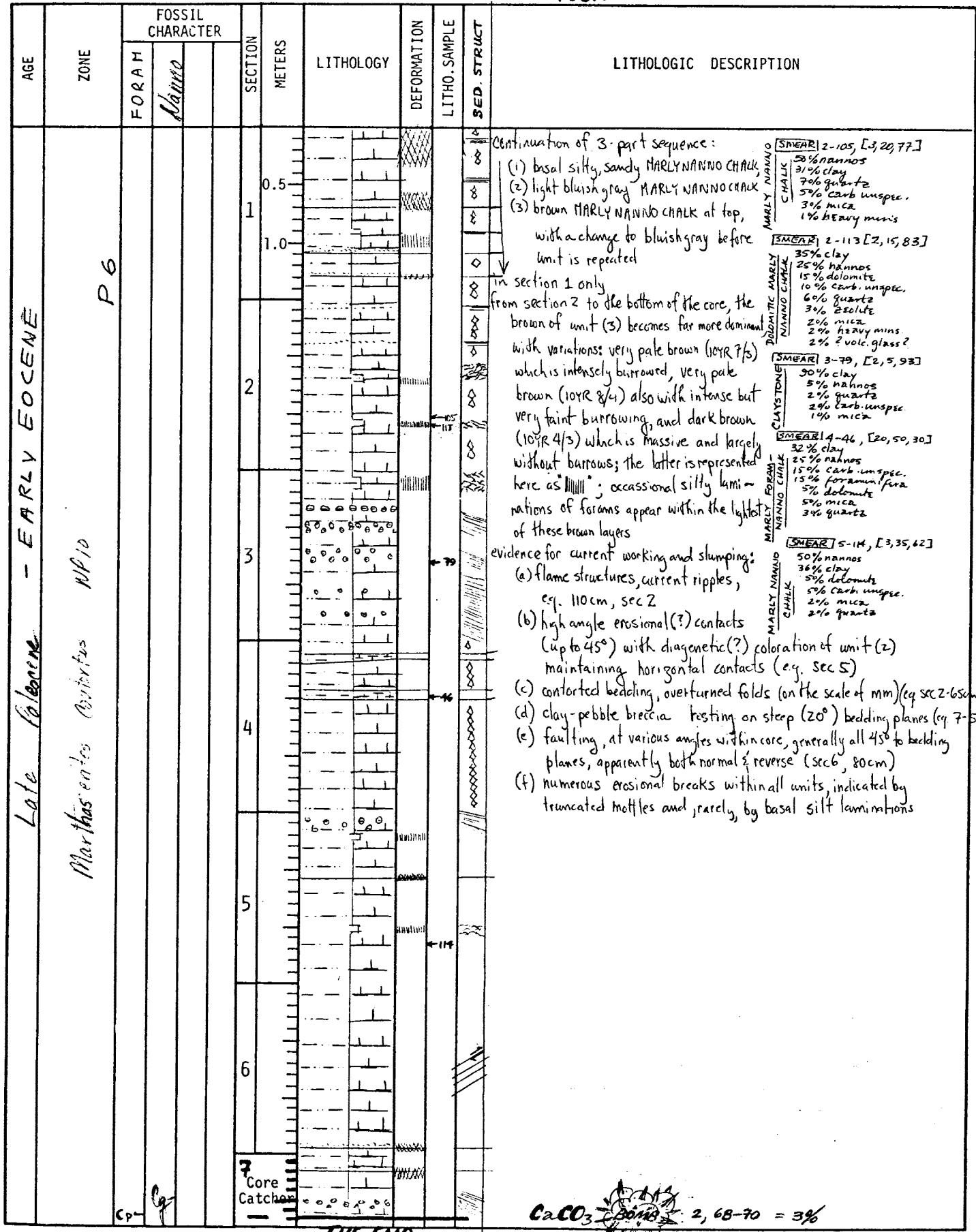
## Explanatory notes in Chapter 1



AGE	ZONE	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCT.	LITHOLOGIC DESCRIPTION	
									FORAM	WOR
EARLY EOCENE	Tribularites orthostylus Nf 12		1	0.5						
			1	1.0						
			2							
			3							
			4							
			5							
			6		"THE END"					
					Core Catcher					
<p style="text-align: right;">566.1 - 567.6, N-9, 10g 5/2 5YR 5/6 - 6/6</p> <p>RHYTHMIC sequence as before but with fewer rhythms expressed, possibly due to increase in sedimentation rate or decrease in silt-sand influx. Two types of siltstones or sandstones: (1) N-9, white carbonaceous sandstones, granules of sparry to micritic calcite (poss. shoal-H<sub>2</sub>O origin), quartz, and foraminifera (2) 10g 5/2 pale gray sandst. to siltst., predominant in this core, graded, laminated to massive, usually &lt; 2cm, often 1-4mm thick, quartz-rich, usually poorly-sorted, fig. to r.f.g. These generally occurs as defined at base of a rhythm. Associated are silty NANNO CHALKS to MARLY CHALKS AND MUDSTONES of 10g 5/2, pale gray and 5g 6/1 to 5g 4 6/1 grayish-gray color, usually &lt; 5-10cm above &amp; below silt or sand bed, gradational change, coloration may be partly diagenetic; higher CaCO<sub>3</sub> in this color than in (1) 5YR 5/6 to 6/6 yellowish-red and reddish yellow, MARLY NANNO CHALK and QUARTZOSE MARLY NANNO CHALK 1-85, [12, 25, 63] 55% clay 30% quartz 6% mica 3% nanos 3% carb.unspec. 2% heavy mins. 1% dolomite 1-48, [5, 20, 75] 30% nanos 30% clay 25% quartz 8% exolite 2% feldspar 2% heavy mins. 1% dolomite 1-49.5, [8, 25, 67] 55% clay 30% quartz 6% mica 3% nanos 3% carb.unspec. 2% heavy mins. 1% dolomite 1-120, [12, 25, 35] 40% nanos 25% carb.unspec. 23% clay 7% quartz 3% mica 2% exolite 1-120, [8, 25, 67] 40% nanos 25% carb.unspec. 23% clay 7% quartz 3% mica 2% exolite</p> <p>① CLAYSTONE composing most of a bed. Bioturbation low throughout (not extremely visible)</p> <p>CaCO<sub>3</sub> BOMB 3, 98-100 = 40%</p>										

### **Explanatory notes in chapter 1**

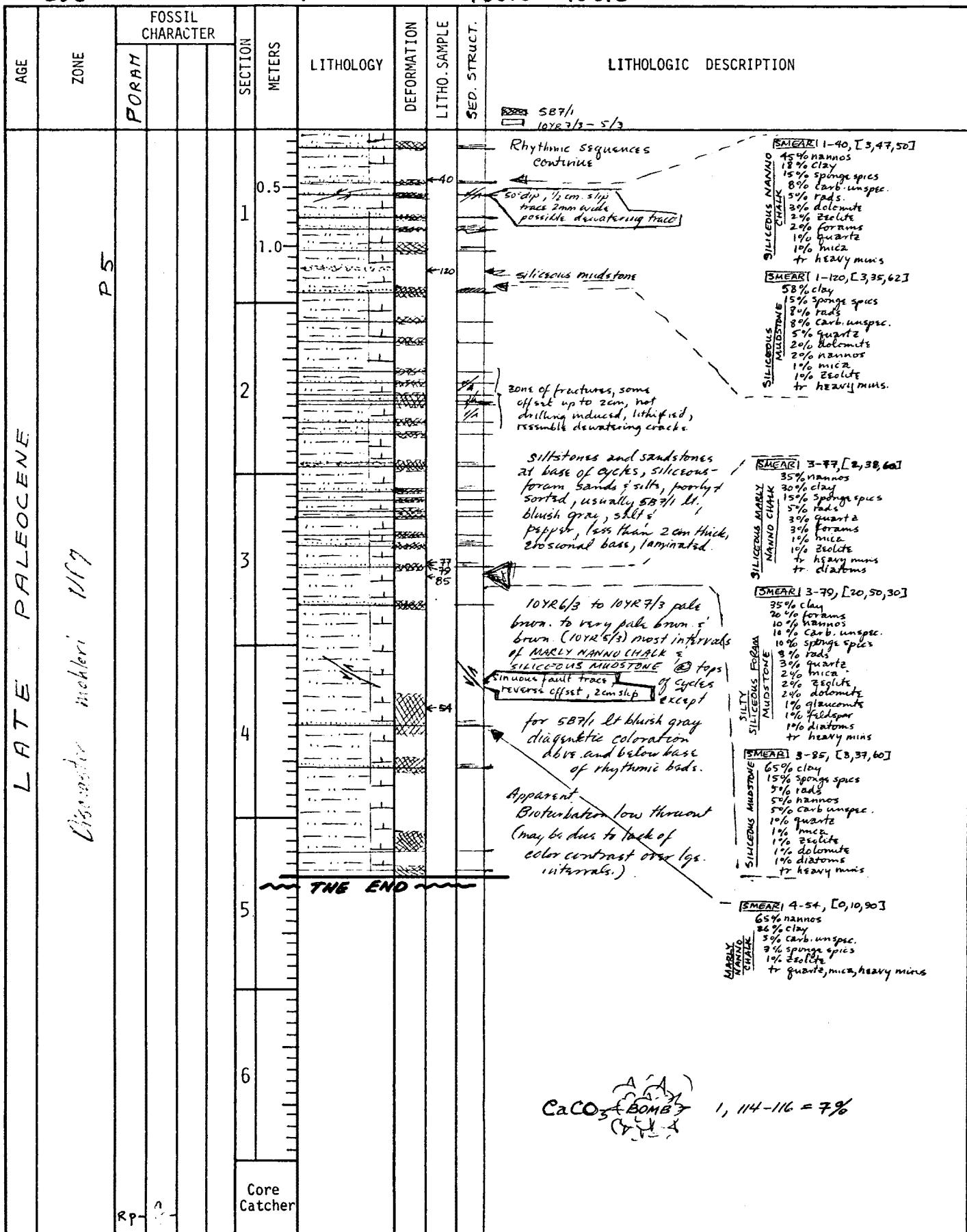
60





Site **398** Hole **D** Core **36** Cored Interval: **746.0 - 755.5**

Site 398 Hole D Core 37 Cored Interval: 755.5 - 765.0



Site 398

Hole D

Core 38 Cored Interval: 765.0 - 774.5

AGE	ZONE	FOSSIL CHARACTER FORAM MAMS	LITHOLOGIC DESCRIPTION				
			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
LATE PALEOCENE	P3/P4	MAMS	1	0.5	Rhythmically repeated sequences as before w/ similar colors	SGY 7/2, 6/2 - 5/2, 10G Y 5/2 10YR 7/3 - 5/3 SYR 4/4	SGY 7/2, 6/2 - 5/2, 10G Y 5/2 10YR 7/3 - 5/3 SYR 4/4
			1	1.0	10YR 7/3 - 5/3 pale brown, to 5YR 4/4 mod. brown to brown.		
			2	0.5	ZEOLITIC MUDSTONE, part, intensely bioturbated, as major part of rhythmic sequence. Rhythms begin usually w/ < 3 cm siltst. or sandstone, often graded and laminated.	SMEARI 1-36, [0, 30, 70]	69% quartz 10% calcite 8% quartz 5% carb.unspec. 5% mams 2% mica 1% dolomite tr forams tr heavy min (tourmaline magnetite)
			2	1.0	Colors SGY 6/2 - 5/2 dusky yellow grn. MARLY CHALK just above and below usually SGY 7/2 to 5YR 5/2, dusky yellow green to grayish green.	SMEARI 1-45, [0, 40, 60]	69% clay 10% calcite 3% dolomite 3% mica 2% carb.unspec. 2% mams 1% feldspar 1% glauconite 1% rads tr sponge spcs tr heavy min
			3	0.5		SMEARI 1-52, [0, 30, 70]	63% clay 20% mams 8% quartz 3% carb.unspec. 2% calcite 2% forams 1% mica 1% dolomite tr heavy min
			3	1.0		SMEARI 1-54, [0, 30, 70]	59% clay 15% mams 10% calcite 10% quartz 3% carb.unspec. 2% mica 1% dolomite tr heavy min
			4	0.5		SMEARI 2-56, [0, 10, 90]	51% clay 9% mams 2% forams 2% carb.unspec. 2% calcite 1% dolomite 1% mica tr heavy min
			4	1.0		SMEARI 2-62, [5, 55, 40]	34% clay 30% mams 15% quartz 10% carb.unspec. 5% pellets 2% mica 2% calcite 1% dolomite 2% heavy min
			5	0.5		SMEARI 2-127, [40, 30, 70]	30% quartz 10% clay 20% carb.unspec. 10% forams 25% mams 3% calcite 2% dolomite 2% mica
			5	1.0	REACH THE END --		
			6	0.5			
			6	1.0			
			Core Catcher				

$\text{CaCO}_3$  BAMS - 2, 83-85 = 7%





Site 398 Hole D Core 41 Cored Interval: 793.5-803.0

### **Explanatory notes in chapter 1**

AGE E Forams	FOSSIL CHARACTER	LITHOLOGIC DESCRIPTION																																																																																																	
		SECTION METERS	LITHOLOGY	DEFORmATION	LITHO. SAMPLE	SED. STRAT.																																																																																													
late Oligocene (Kangaroo or Maestricht)	Forams Forams Forams	0.5			24																																																																																														
		1			51																																																																																														
		1.0			52																																																																																														
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		5																																																																																																	
		6																																																																																																	
			Core Catcher																																																																																																
<p>Rhythmic sedimentation on the basis of sedimentary facies, bioturbation and color changes. Two main groups of facies are present (a) thin sequences of silty-sandy laminated, fractured mudstone grading upward into fine grained mudstone, siltstone layers at base of sequences are 1-3 mm maximum and they show minor bioturbation; (b) relatively burrowed brown to light brown MARLY NANNO CHALK, occasionally there are greenish gray layers (&gt;2cm) whether this units which may be attributed to the top layer of the sequences (a)</p> <p><i>CaCO<sub>3</sub> EUBONB</i></p>																																																																																																			
<p><b>Smear</b> 1-24 [8,12,80]  <table border="1"> <tr><td>MARLY NANNO</td><td>55%</td><td>nannos</td></tr> <tr><td>CHALK</td><td>25</td><td>clay</td></tr> <tr><td></td><td>5</td><td>carb.unspec.</td></tr> <tr><td></td><td>5</td><td>pellets</td></tr> <tr><td></td><td>5</td><td>quartz</td></tr> <tr><td></td><td>2</td><td>mica</td></tr> <tr><td></td><td>2</td><td>dolomite</td></tr> <tr><td></td><td>1</td><td>heavy mins</td></tr> </table>   <b>Smear</b> 1-51 [8,15,77]  <table border="1"> <tr><td>MARLY NANNO</td><td>55%</td><td>nannos</td></tr> <tr><td>CHALK</td><td>26</td><td>clay</td></tr> <tr><td></td><td>3</td><td>carb.unspec.</td></tr> <tr><td></td><td>3</td><td>mica</td></tr> <tr><td></td><td>2</td><td>pellets</td></tr> <tr><td></td><td>2</td><td>dolomite</td></tr> <tr><td></td><td>2</td><td>heavy mins</td></tr> </table>   <b>Smear</b> 1-54 [10,15,75]  <table border="1"> <tr><td>MARLY NANNO</td><td>55%</td><td>nannos</td></tr> <tr><td>CHALK</td><td>25</td><td>clay</td></tr> <tr><td></td><td>5</td><td>quartz</td></tr> <tr><td></td><td>4</td><td>mica</td></tr> <tr><td></td><td>3</td><td>dolomite</td></tr> <tr><td></td><td>3</td><td>carb.unspec.</td></tr> <tr><td></td><td>2</td><td>pellets</td></tr> <tr><td></td><td>2</td><td>heavy mins</td></tr> <tr><td></td><td>1</td><td>pyrite</td></tr> </table>   <b>Smear</b> 1-55 [12,20,68]  <table border="1"> <tr><td>MARLY NANNO</td><td>60%</td><td>nannos</td></tr> <tr><td>CHALK</td><td>20</td><td>clay</td></tr> <tr><td></td><td>10</td><td>quartz</td></tr> <tr><td></td><td>5</td><td>carb.unspec.</td></tr> <tr><td></td><td>2</td><td>mica</td></tr> <tr><td></td><td>2</td><td>dolomite</td></tr> <tr><td></td><td>1</td><td>heavy mins</td></tr> </table> </p>							MARLY NANNO	55%	nannos	CHALK	25	clay		5	carb.unspec.		5	pellets		5	quartz		2	mica		2	dolomite		1	heavy mins	MARLY NANNO	55%	nannos	CHALK	26	clay		3	carb.unspec.		3	mica		2	pellets		2	dolomite		2	heavy mins	MARLY NANNO	55%	nannos	CHALK	25	clay		5	quartz		4	mica		3	dolomite		3	carb.unspec.		2	pellets		2	heavy mins		1	pyrite	MARLY NANNO	60%	nannos	CHALK	20	clay		10	quartz		5	carb.unspec.		2	mica		2	dolomite		1	heavy mins
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	1	heavy mins																																																																																																	

AGE	FOSSIL CHARACTER	SECTION	LITHOLOGIC DESCRIPTION				
			METERS	LITHOLOGY	DEFOR.	LITHO. SAMPLE	SED. STRUCTURES
Late Cretaceous Post-tectonic	Fossils <i>Nannoplankton</i>	1	0.5				
Maestrichtian		1	1.0				
Lithophiles questionable (?)	Cp ff	2					
		3					
		4					
		5					
		6					
		Core Catcher					

Site 398 Hole D Core 44 Cored Interval: 822,0-831,5

AGE	Fossil Zone	FOSSIL CHARACTER		SECTION	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SEQ. STRUCT.	LITHOLOGIC DESCRIPTION	
		Facies	Meter							
Late Cretaceous	Maastrichtian	Cf	Rf-	1	0.5				8	Rhythmic sedimentation as noted in previous cores: (1) basal silty/flothy laminations to silty mudstone 1-3 mm thick, color blues and grays (50%), basal contact usually erosional and marked by a thin pyritized siltstone laminae. It grades upward into (2) light bluish gray (50%) MARLY NANNO CHALK that become brown upward and increases in bioturbation, usually of the type "layer by layer". Some burrow. thickness 3-10 cm. (3) brown (7.5 yr <sup>3/4</sup> -5 yr <sup>1/4</sup> ) to yellowish brown (10 yr <sup>1/4</sup> ) variegated MARLY NANNO CHALK, generally intensely bioturbated, some below burrows (bluish gray). This is the predominant facies type in this core (about 90% of total thickness). This facies usually display a layer 3-10 cm thick of bluish gray before the sequence is repeated. slight changes in facies within this unit are attributed to small changes in bottom current activity, dissolution and terrigenous input.
				2	1.0					
				3						
				4						
				5						
				6						
				Core Catcher						
<u>THE END</u>										
$\text{CaCO}_3 = \frac{11}{1} \text{ BOMB } \frac{1}{1}$ 6:118-120-41% P. S. SILSTONE 112 113 114 115 116 117 118 119 120 121 122										
<b>Smear 1-8 [0, 10, 90]</b> MARLY NANNO CHALK 56% nannoscay 35 nannos 4 quartz 2 carb. unspec. 1 mica 1 dolomite 1 feldspar 1 heavy min.  <b>Smear 1-19 [0, 10, 90]</b> MARLY NANNO CHALK 64% clay 2 nannos 3 quartz 2 carb. unspec. 1 mica 1 dolomite 1 organic mat. 1 heavy min.  <b>Smear 1-21 [0, 30, 70]</b> MUDSTONE 50% clay 2 nannos 8 quartz 3 organic mat. 2 mica 1 dolomite 1 heavy min.  <b>Smear 1-24 [0, 10, 90]</b> MARLY NANNO CHALK 61% clay 30 nannos 3 quartz 2 mica 2 carb. unspec. 1 dolomite 1 organic mat. 1 heavy min.  <b>Smear 6-113 [1, 15, 84]</b> MARLY NANNO CHALK 62% clay 2 nannos 3 mica 3 quartz 1 feldspar 1 dolomite 1 heavy min.  <b>Smear 6-121 [2, 15, 83]</b> MARLY NANNO CHALK 55% clay 30 nannos 8 quartz 3 mica 3 carb. unspec. 1 organic mat. 1 heavy min.  <b>Smear 6-122 [15, 35, 50]</b> MUDSTONE 32% clay 2 nannos 20 quartz 8 carb. unspec. 3 mica 2 dolomite 1 feldspar 1 mica 2 dolomite 2 feldspar 2 glauconite 1 heavy min.										

Site 398 Hole D Core 46 Cored Interval: 841,0 - 850,5

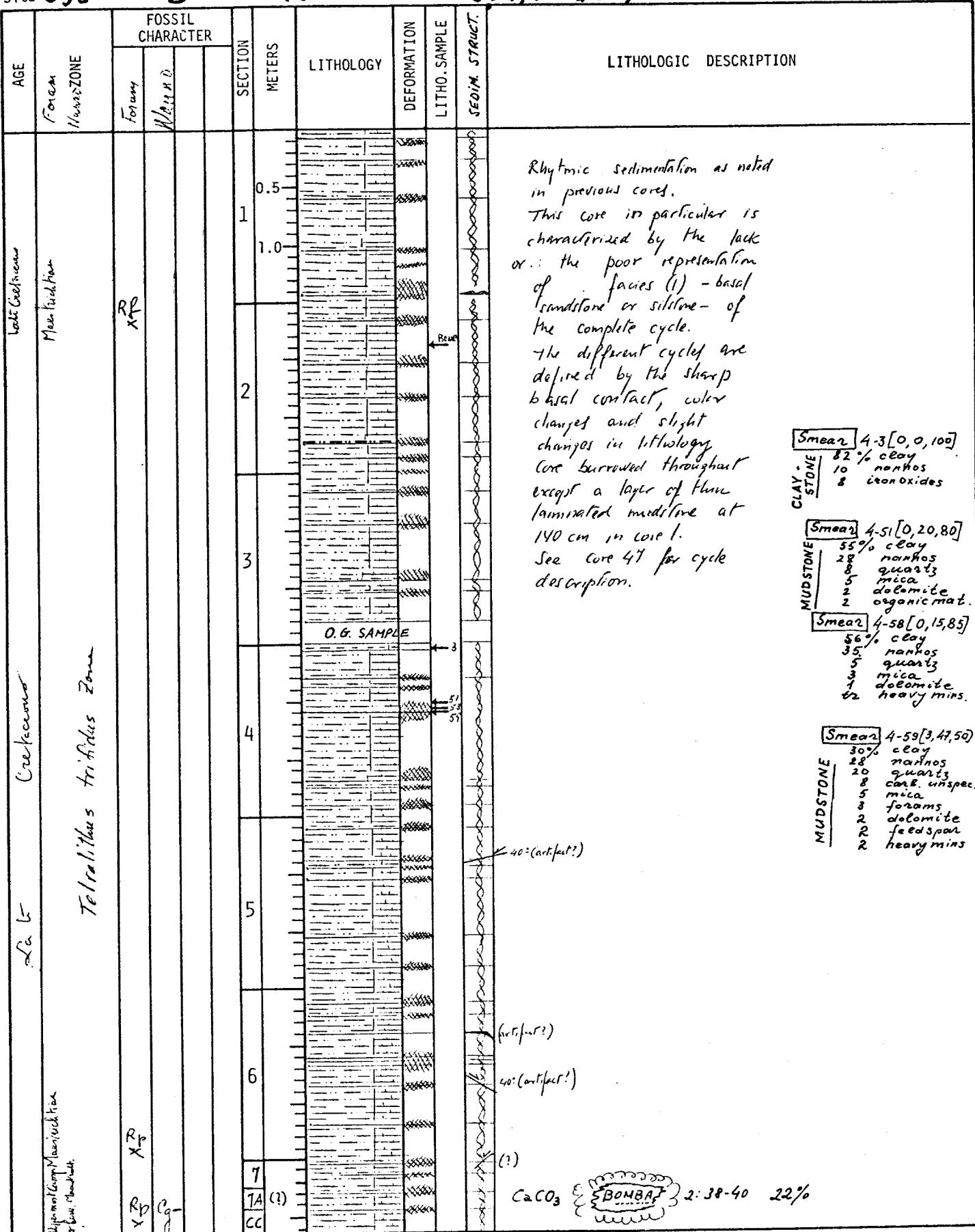
Site 398 Hole D Core 47 Cored Interval: 850,5-860,0

Site 398

Hole D

Core 48 Cored Interval:

860.0 - 869.5



AGE	FORAM PLACOID LIZARDA ZONE	FOSSIL CHARACTER		SECTION	LITHOLOGY	DEFORMATION	LITHOLOGIC DESCRIPTION	
		METERS	LITHO. SAMPLE				SEDIM. STRUCT.	
late Cretaceous	Campanian - <i>Bransonia parva</i> Zone	X <sub>2</sub> Foram Placoid Lizarda	Foram Placoid Lizarda	0.5 1 1.0 2 3 4 5 6 Core Catcher	THE END			Rhythmic sedimentation as noted in cores 48 and 47. See core 47 for description of the cycles.

Site **398** Hole **D** Core **50** Cored Interval: **879,0 - 888,5**



Site 398 Hole D Core 52 Cored Interval: 898,0 - 907,5

### Explanatory notes in chapter 1

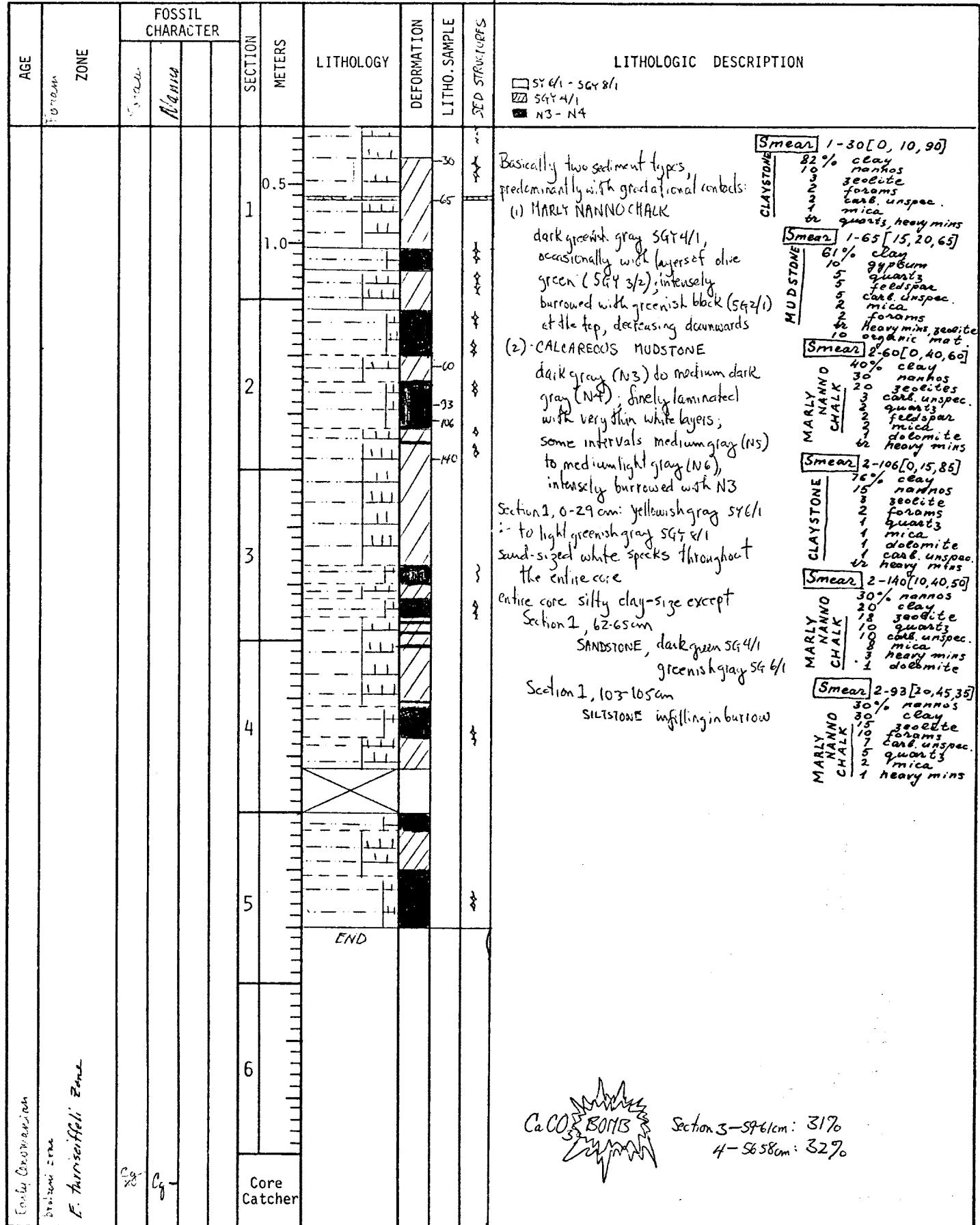
Site 398 Hole D Core 53 Cored Interval: 907.5-917.0

AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SEDIM. STRUCT.	LITHOLOGIC DESCRIPTION	
		1	2							3	4
Late Ordovician	Bowen	Rg Xg	Rg Xg	1	0.5 1.0	1.0		58		Similar to cores 52 and 53 Predominantly homogeneous, unbedded, unfossiliferous CLAYSTONE dark reddish gray (5YR 1/2). Two variations: (1) Rare light bluish gray (5B 1/2) layers with silty laminations (2) Mottled and variegated intervals dark gray (5YR 1/2) 1-5 cm thick In section two there are some light brownish gray (10YR 1/2) mottled laminations	CLAYSTONE Smear 1-58 [0, 15, 85] 85% clay 5 quartz 4 dolomite 3 oxides 2 chert 1 feldspar 62 mica 62 heavy mins.
?		Tk 0-		2		2		60		CLAYSTONE Smear 1-59 [0, 30, 70] 65% clay 10 dolomite 8 authig. opal 5 quartz 3 mica 3 zeolite 1 feldspar 5 oxides 62 heavy mins.	
				3		3				CLAYSTONE Smear 2-60 [0, 20, 80] 80% clay 8 zeolite 3 quartz 3 mica 3 oxides 2 dolomite 1 feldspar 62 heavy mins.	
				4							
				5							
				6							
						Core Catcher					

AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO SAMPLE	SEDIM. STRUCT.	LITHOLOGIC DESCRIPTION	
		Fossil	Notes								
Cambrian	Barrow	R <sub>3</sub>	R <sub>3</sub> , R <sub>2</sub> , R <sub>1</sub>	1	0.5					Predominantly homogeneous or faintly laminated, unbioturbated unfossiliferous dark reddish brown to yellowish red CLAYSTONE. Some thin sequences formed by (1) basal silty or sandy MUDSTONE bluish gray (56%), laminated, graded (?) and with sharp basal contact: 0-2 mm thick (2) it is followed by a layer 1-2 cm thick of bluish gray (56%) MUDSTONE, which grades into the dark reddish CLAYSTONE. Two variations in the CLAYSTONE: (a) laminated yellowish red (54%) claystone, which expands as it dries, and (b) massive claystone, homogeneous	Smear 1-50 [0,20,80] 77% clay 12% zeolite 3 quartz 3 mica 3 oxides 1 feldspar 1 dolomite 2 heavy mins
		R <sub>2</sub>	R <sub>2</sub>	2	1.0			50		CLAYSTONE Smear 2-19 [0,20,80] 77% clay 12% zeolite 5 quartz 5 mica 1 feldspar 62 heavy mins	
		R <sub>1</sub>	R <sub>1</sub>	3	2			19		CLAYSTONE Smear 2-24 [0,30,70] 71% clay 20% zeolite 5 quartz 3 mica 1 feldspar 62 heavy mins	
				4	2.5			24		MUDSTONE Smear 2-24,5 [0,30,70] 70% clay 15% quartz 8% zeolite 5 mica 2 feldspar 62 heavy mins	
				5	3			25			
				6	4						
					Core Catcher						

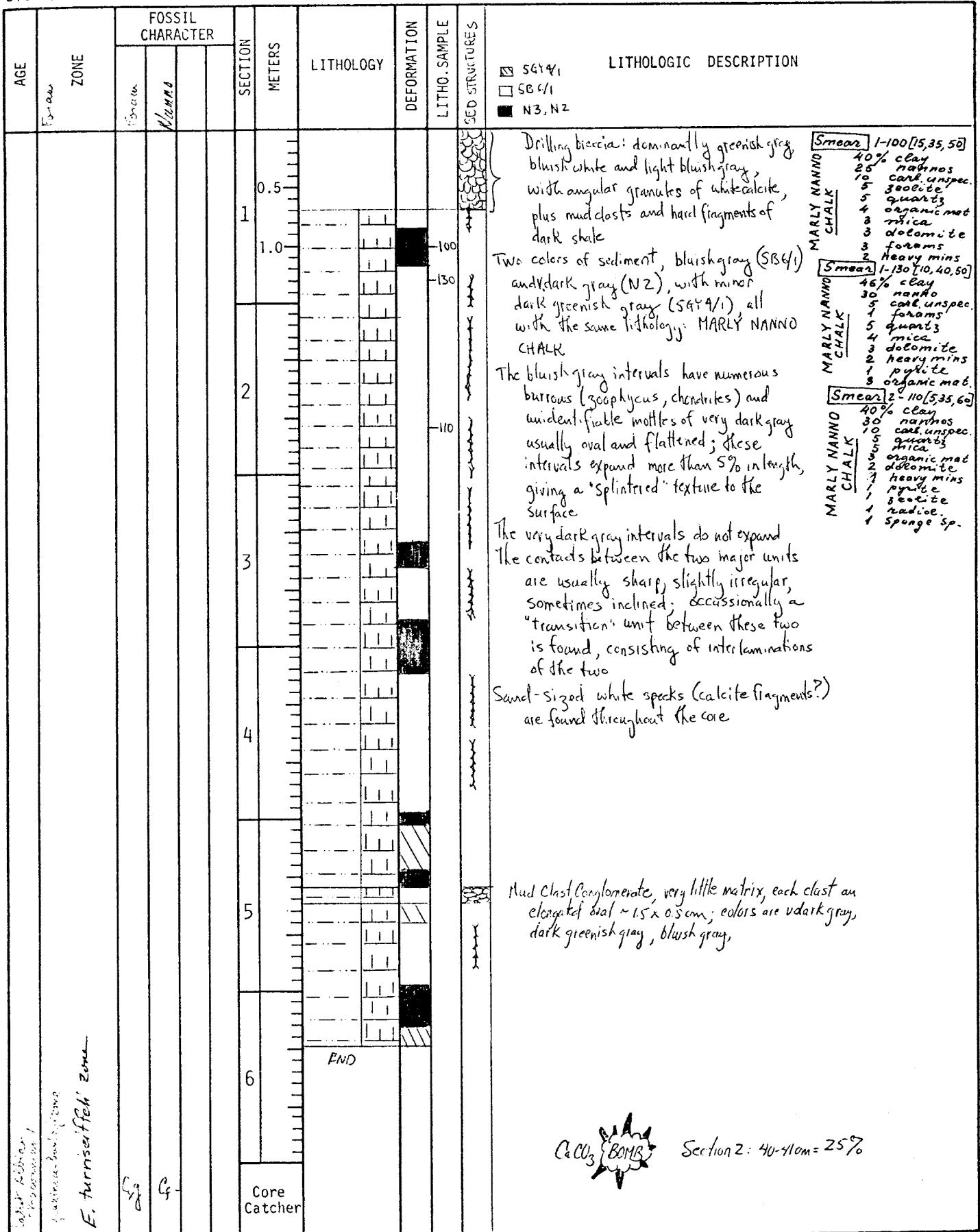
CaCO<sub>3</sub> 1-62.64 4%

## Explanatory notes in chapter 1



Site 398 Hole D Core 58 Cored Interval: 964.5 - 974.0

Site 398 Hole D Core 59 Cored Interval: 974.0 - 983.5



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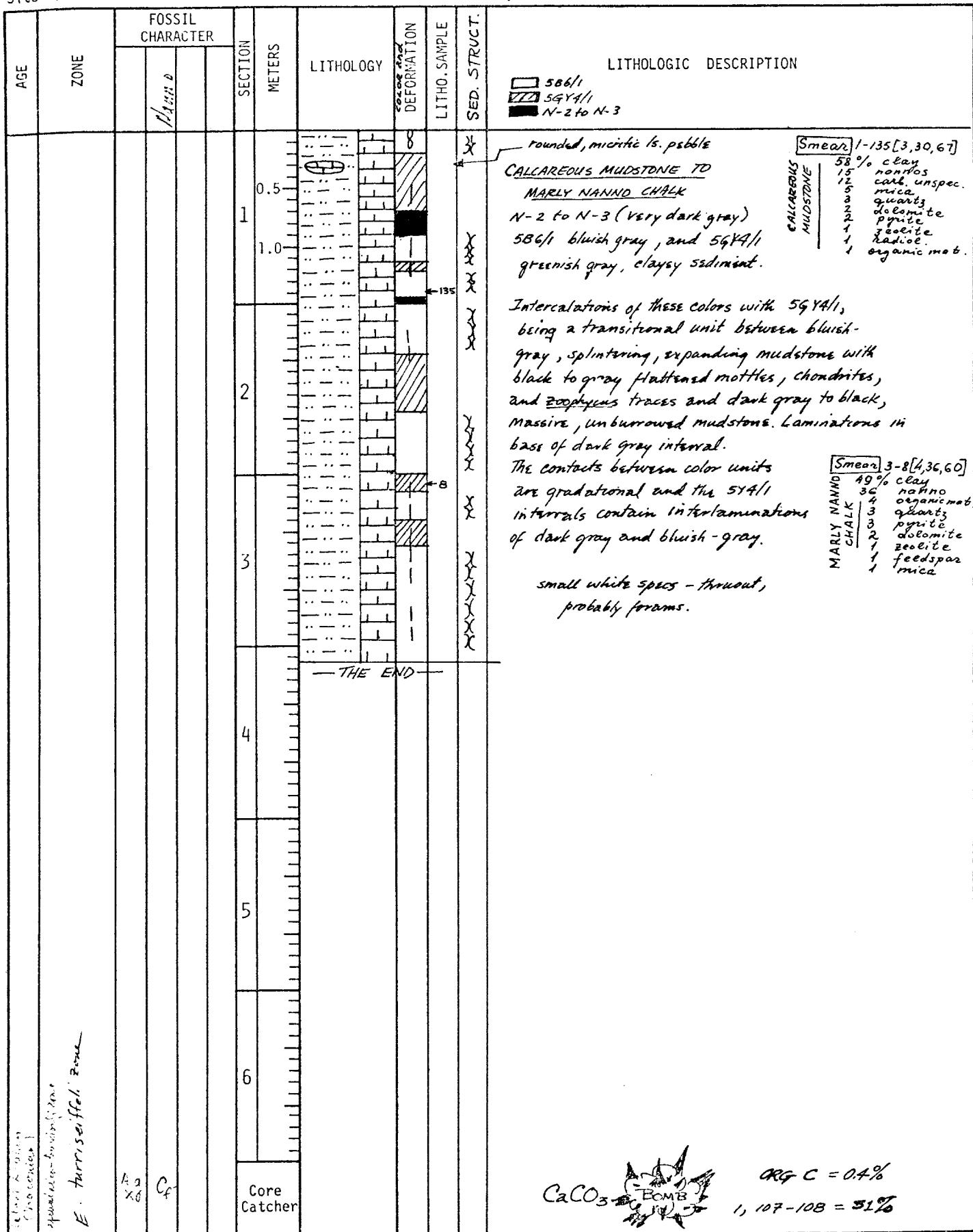
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### *E. terriserifffii* zone

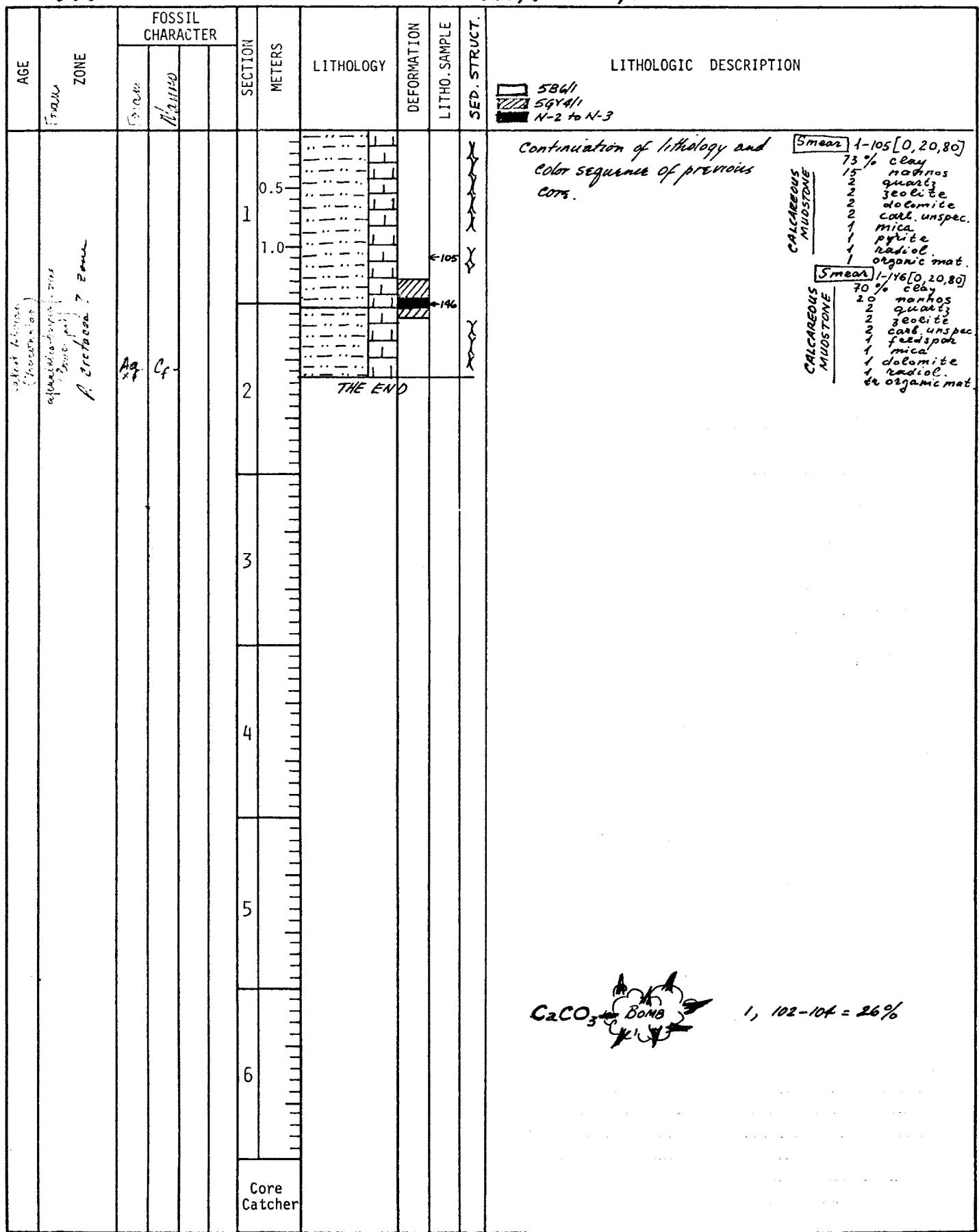
69

## Explanatory notes in chapter 1

Site 398 Hole D Core 60 Cored Interval: 983,5 - 993,0



Site 398 Hole D Core 61 Cored Interval: 993,0 - 1002,5

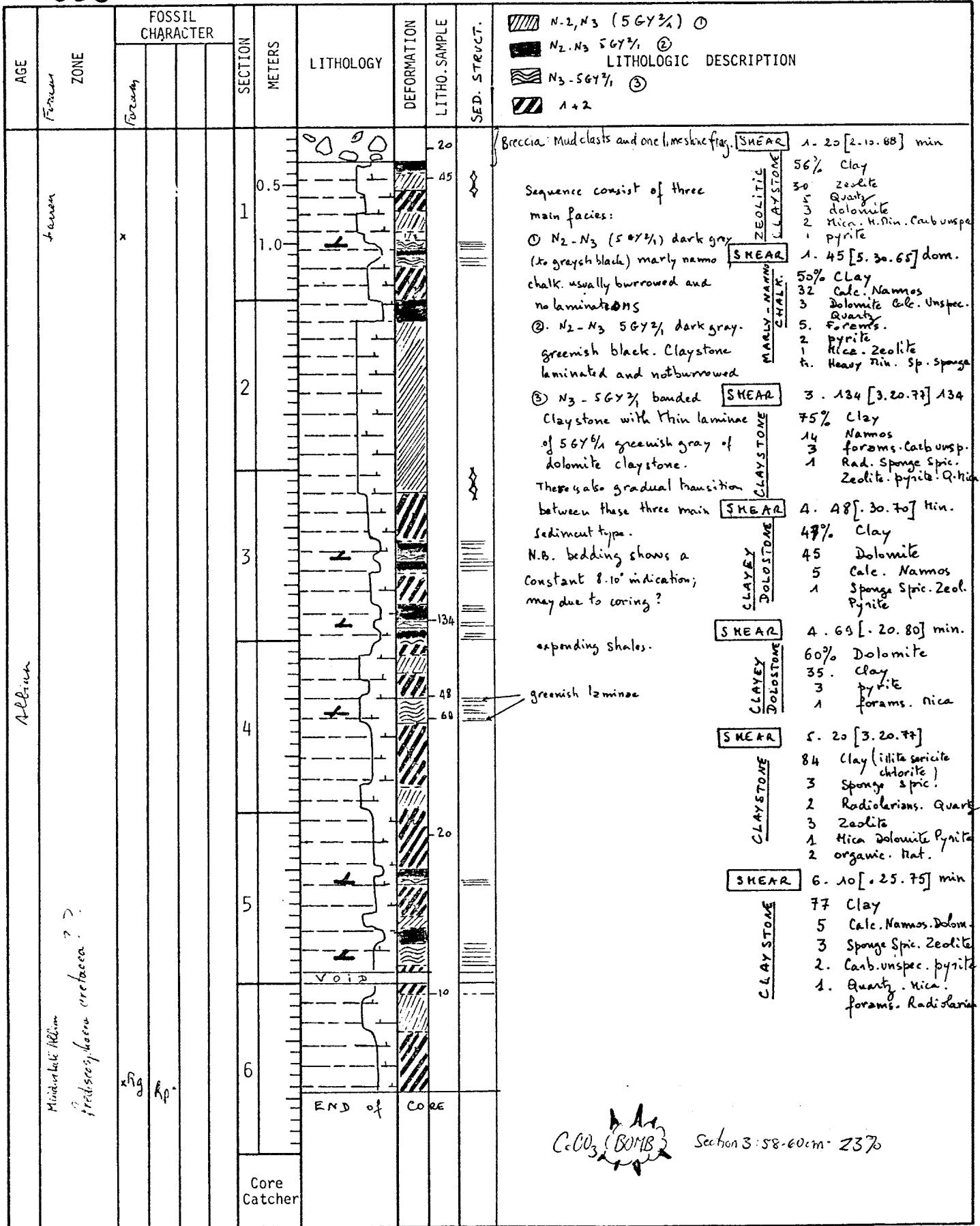


Site 398 Hole D corer 62 Cored Interval: 1002.5 - 1012 m

AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCT.	LITHOLOGIC DESCRIPTION	
		Forams	Nann.								
Initial Atria (Vicariance) open marine-brown top zone (Core joint) ?	Ag Xg R <sub>p</sub> -	Core Catcher	Core	THE END	0.5	1	SG6/1	SGY4/1	N-2 - N-3	Sequence consists of <u>MUDSTONE</u> to <u>CALCAREOUS</u> <u>MUDSTONE</u> of (N-2 to N-3) dark gray to gray-black, (SGY4/1) dark greenish gray, a transitional lithology between the N-2, N-3 mudstones and a bioturbated (SG6/1) bluish-gray mudstone.	1-30 [3.20.77] dom. 78% Clay 10 Nannos 3 Micas 2 Zeolite 2 radiolarians 1 Quartz, Pyrite, Dolomite 2 Organic mat 1 Heavy Min
					1.0	2				Contacts gradational, some lamination, black to gray units massive and unburrowed.	1-140 [2.15.83] dom. 79% Clay 10 Nannos 3 Quartz 2 radiolarians, volc. glas. 4 Mica, H. Min., Pyrite Dolomite, calc. unsp.
					1.5	3				- Lamination N-7 (lt. gray) dolomitic mudstone	2.-148 [5.20.75] dom. 62% Clay 18% nannos 5 Forams; Calc unspec. 3 Quartz 2 Zeolite 1 Mica, Volc. Glass, diat. sp. spic. Pyrite H. Min. Radiol.
					2.0	4				? several dark gray laminated intervals in predominantly bluish-gray interval	2-150 [2.1830] min. 59% Clay 30% Dolomite 5% Nannos 2 Forams, Carb.unspec. 1 Zeolite, Quartz 1 Mica, Heavy. Min
					2.5	5				N-7 (lt. gray) laminations fault below which all lamins. & mottles dip $\approx 20^\circ$ (drilling artifact?)	5-138 [2.48.50] min. 55 Clay 30 Zeolite 8 Feldspat 3 Quartz 2 Calc. nannos 1 Calc. unspec. Mica. dolomite. Pyrite
					3.0	6				- zeolitic mudstone N-7 (lt. gray) w/ darker gray (N-2) lamin. at top. Olive gray burrow mottles	7-15 [15.20.65] min. 70% Clay 8 Zeolite 5 Forams, Nannos 2 Dolomite Carb.unsp. 2 radiolarians 1 Quartz, Volc. glass Spong. spic. Pyrite
					3.5					another fault ( $10^\circ$ dip discrepancy on either side)	
					4.0						
					4.5						
					5.0						
					5.5						
					6.0						

infest Africa?  
Via common  
open water (green top)  
(store joint)

Site 398 Hole D Core 63 Cored Interval: 1012 - 10215 m



1021.5 - 1031 m

Interval 64

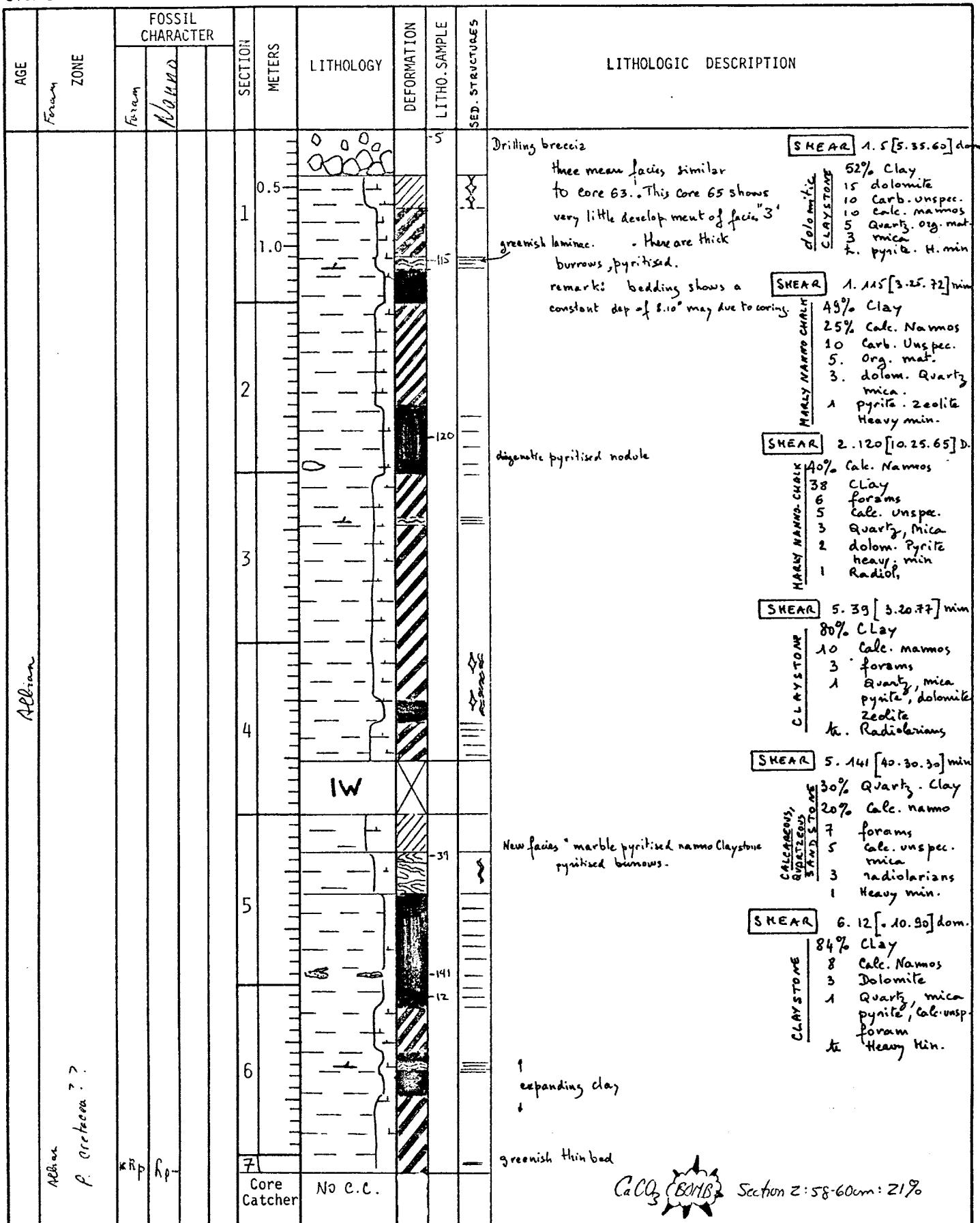
398 m

LITHOLOGIC DESCRIPTION

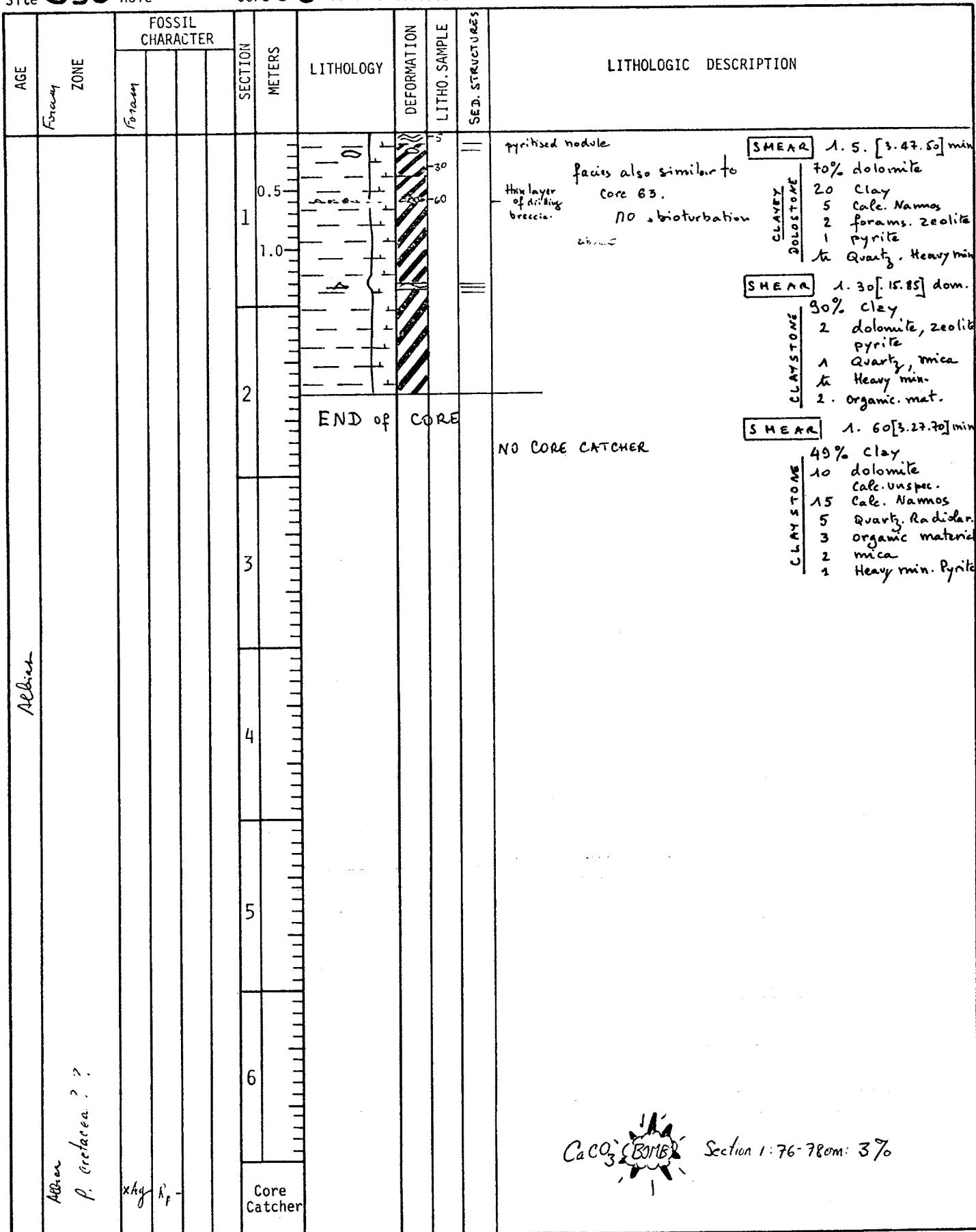
No RECOVERY

FOSIL CHARACTER	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED STRUCTURES
SECTION	Core Catcher				
398					
398					

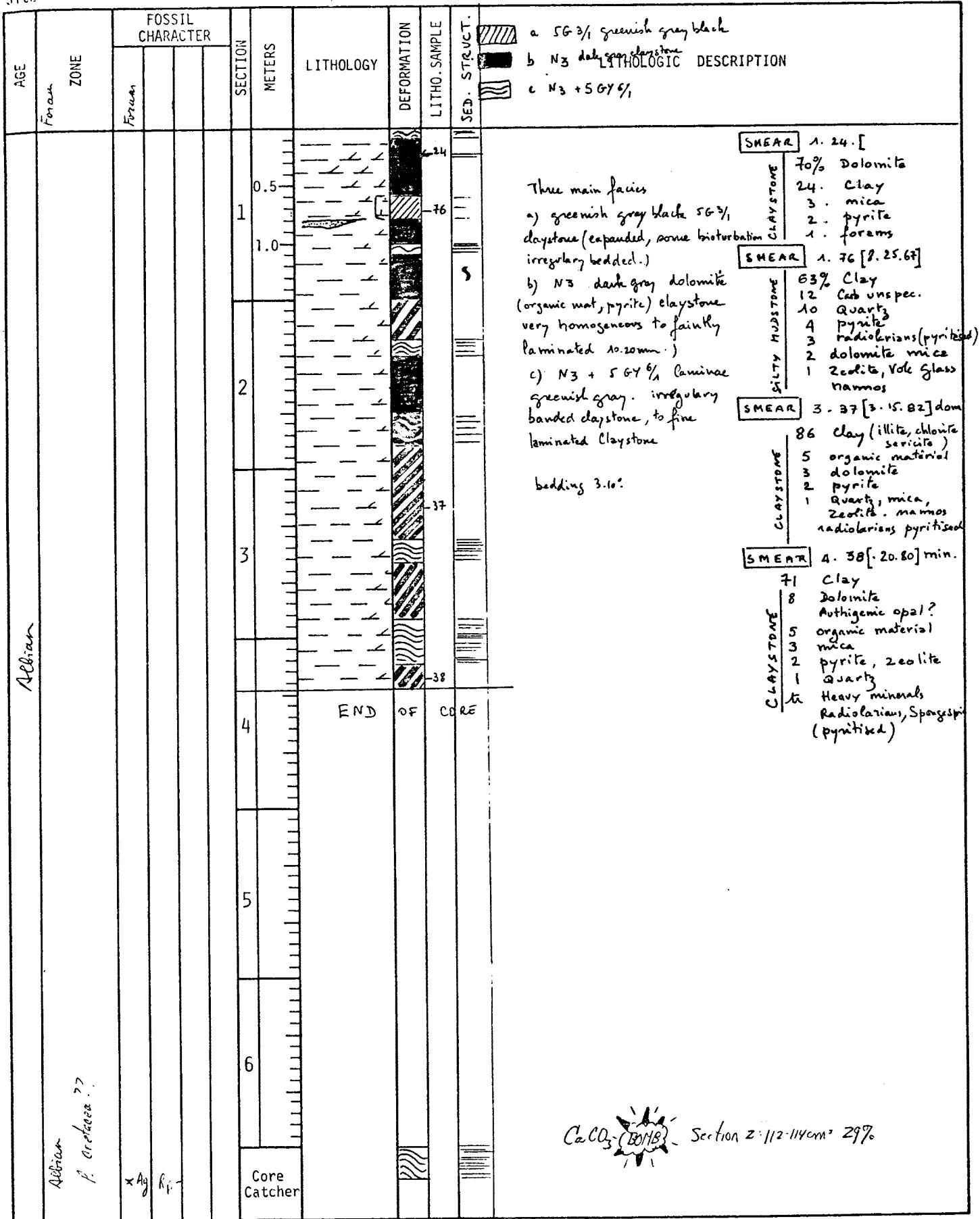
Site 398 Hole D Core 65 Cored Interval: 1031 - 1040.5



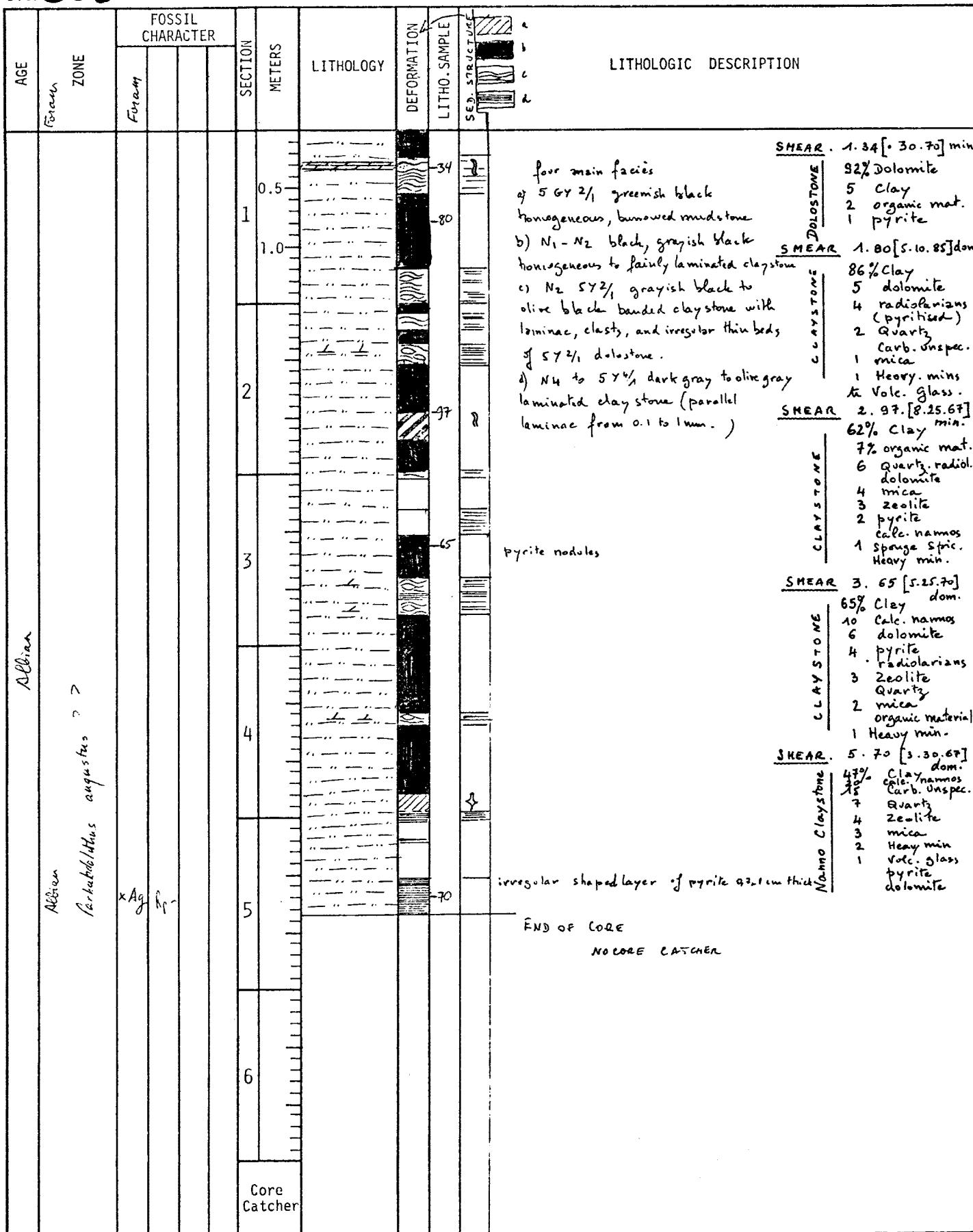
Site 398 Hole D Core 66 Cored Interval: 1040.5 - 1050 m



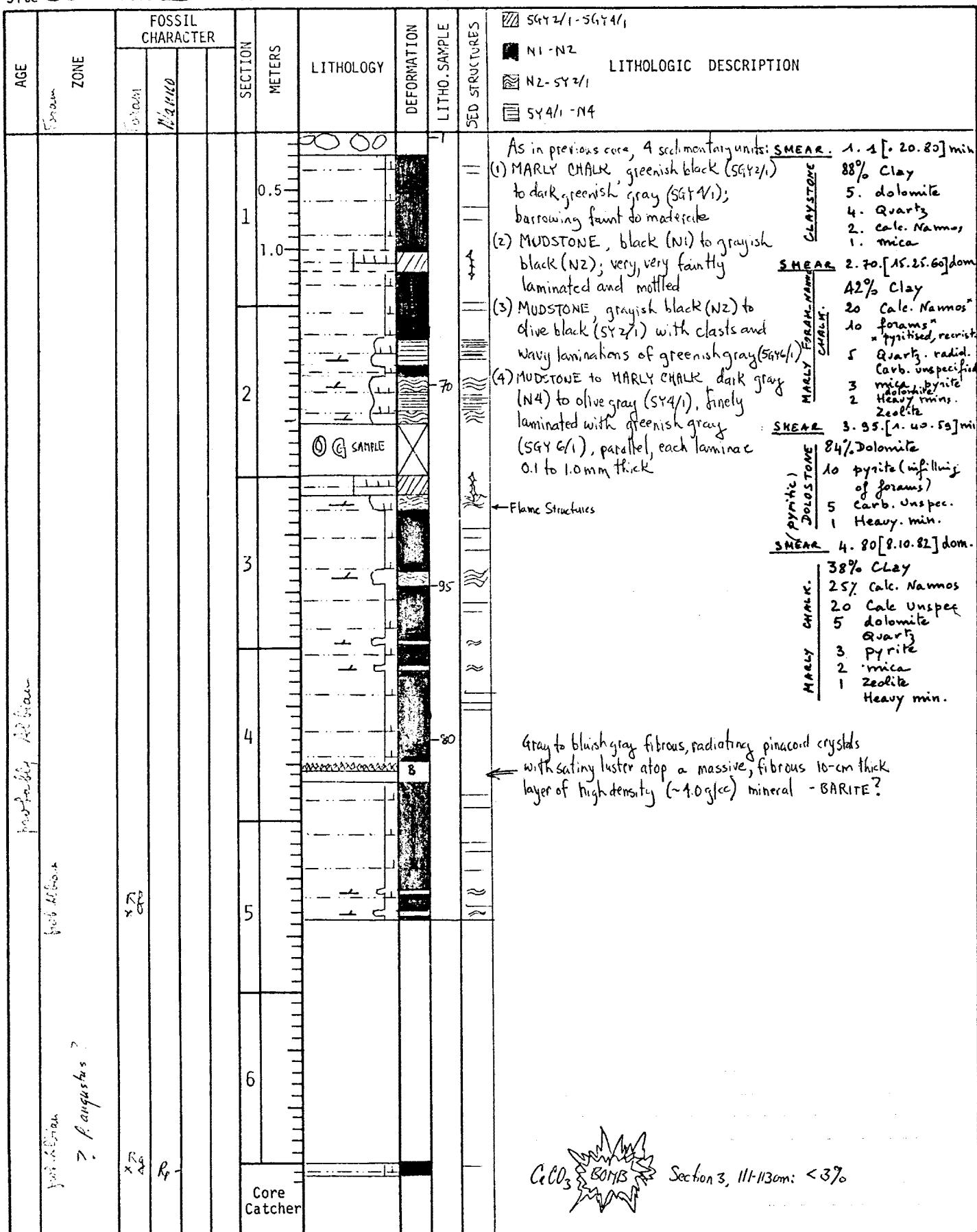
Site 398 Hole D Core 67 Cored Interval: 1050. 1059.5



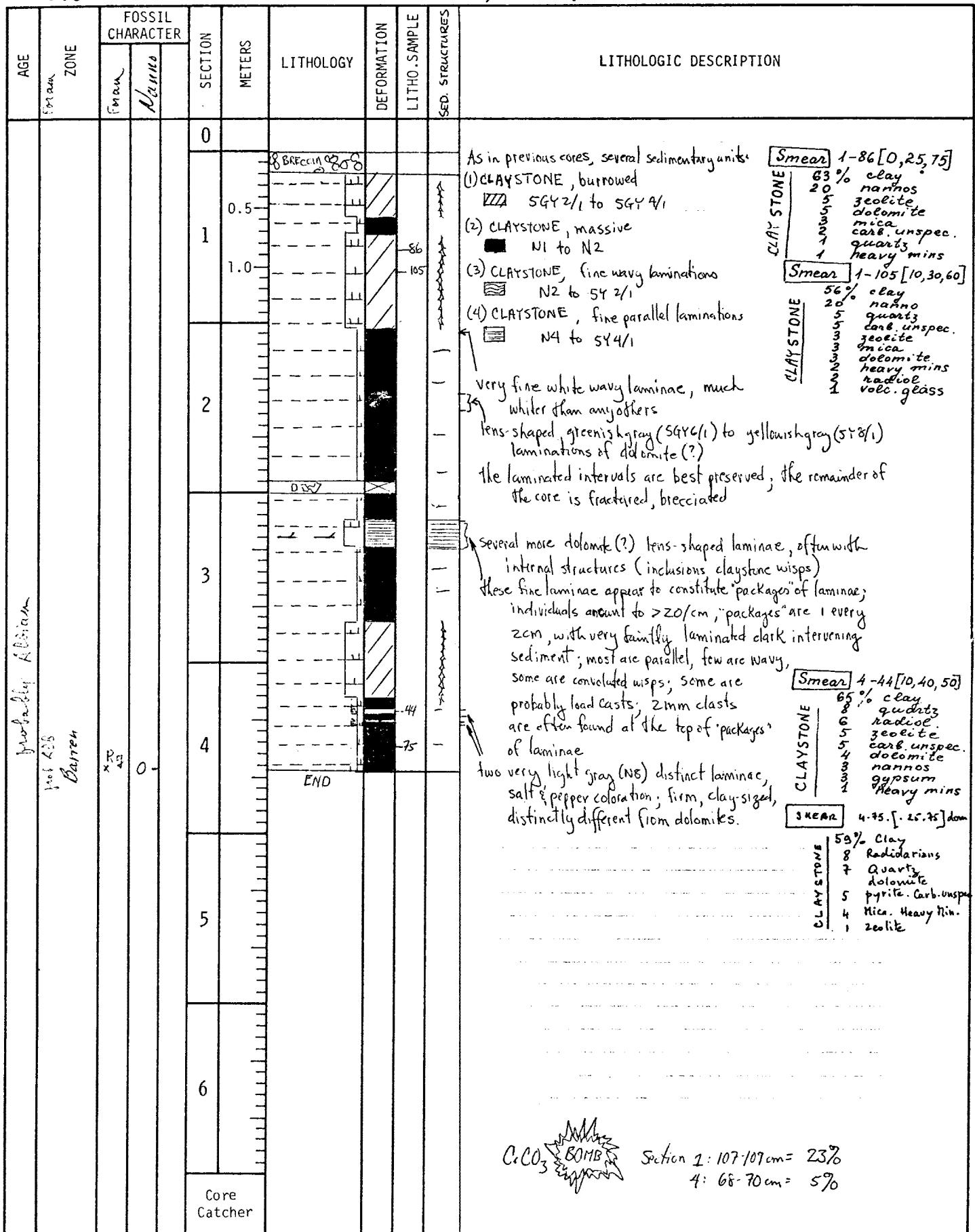
Site 398 Hole D Core 68 Cored Interval: 1059.5 - 1069 m



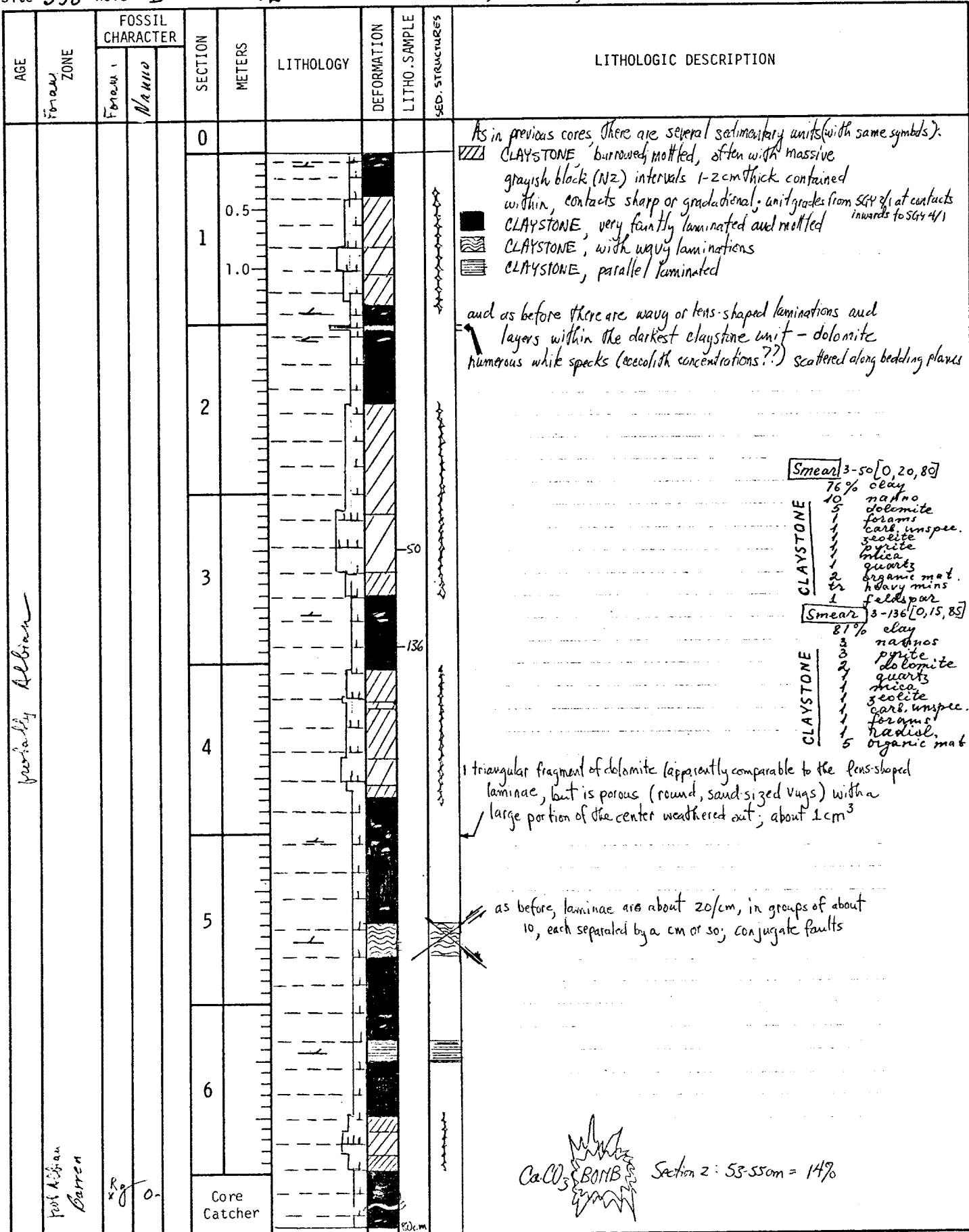
Site 398 Hole D Core 69 Cored Interval: 1069 - 1078.5 m

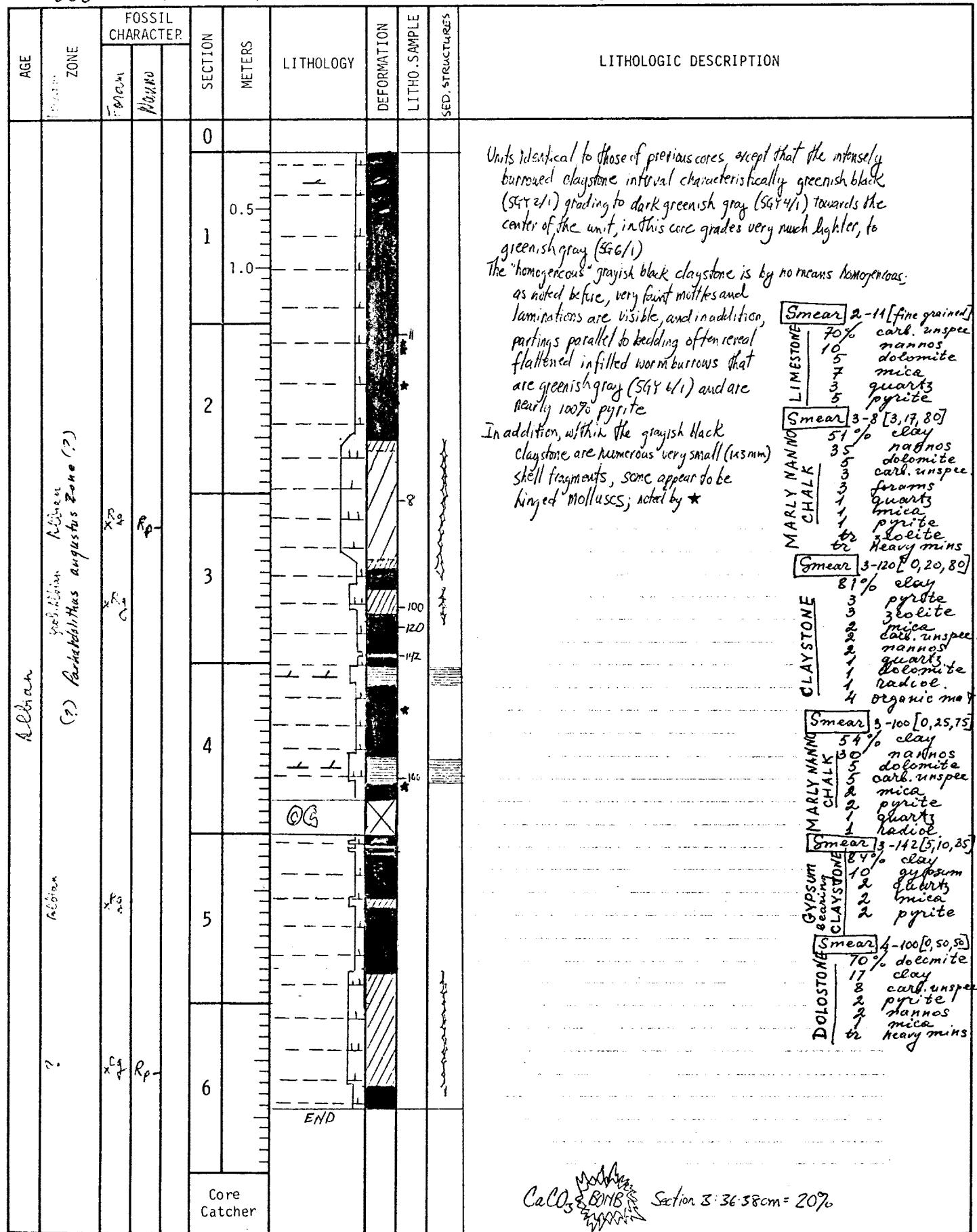


Site 398 Hole D Core 70 Cored Interval: 1078,5 - 1088,0



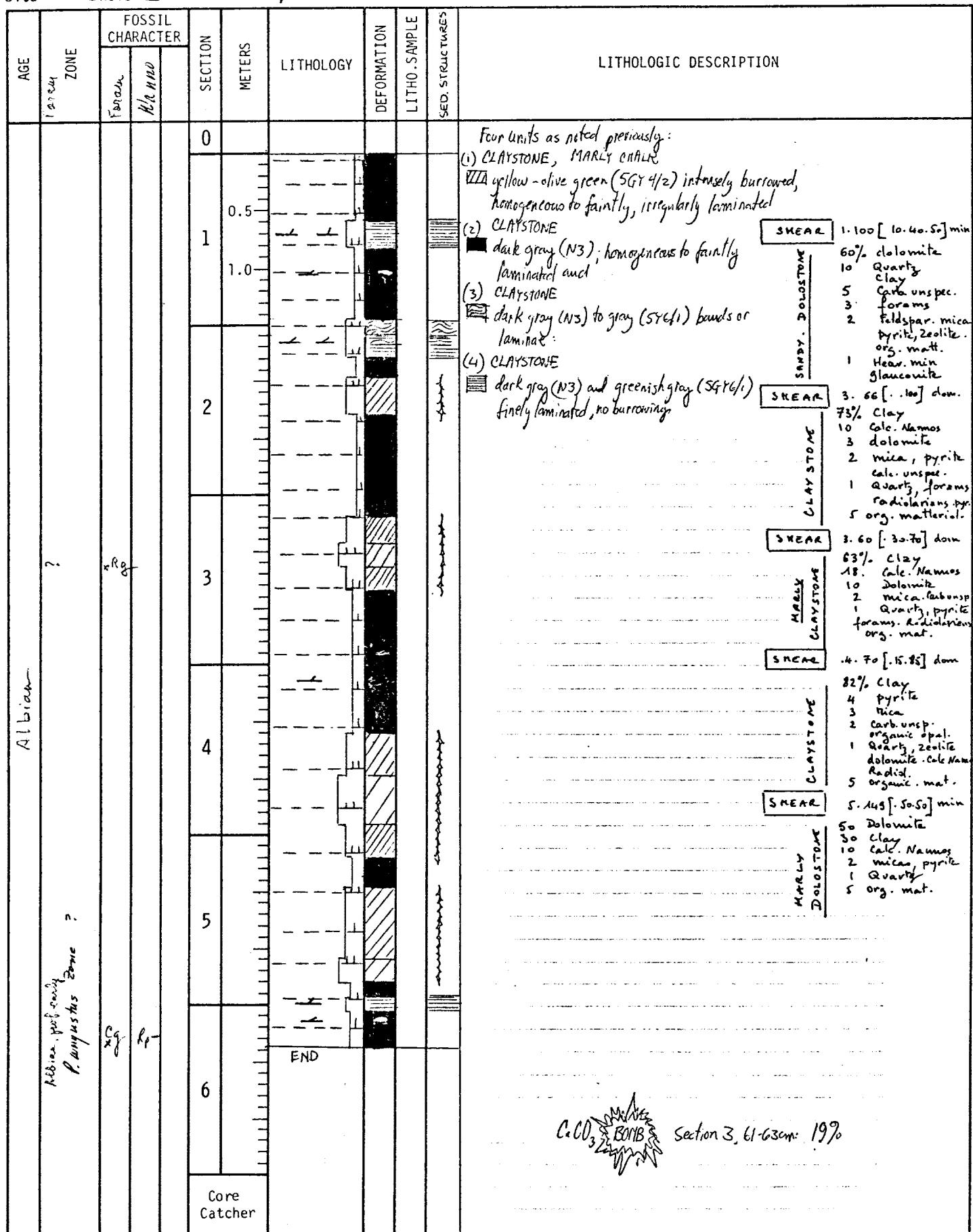
Explanatory notes in Chapter 1



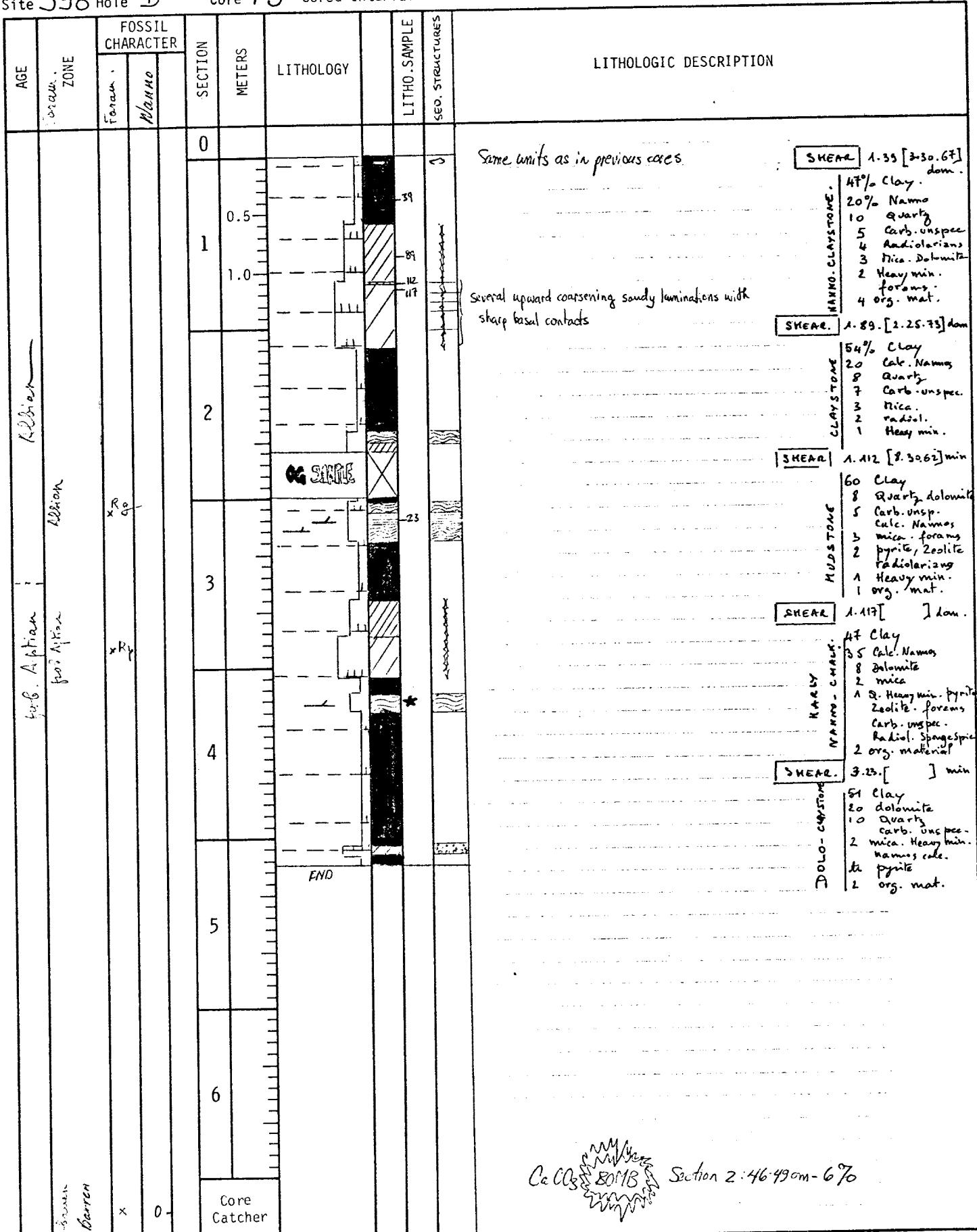


Site 398 Hole D

Core 74 Cored Interval: 5026 - 5035.5 m



Site 398 Hole D Core 75 Cored Interval: 1135.5 - 1145 m.



Site 398 Hole D Core 76 Cored Interval: 1145 - 1154.5 m.

## **Explanatory notes in Chapter 1**

Site 398 Hole D Core 77 Cored Interval: 1164 - 1173.5 m.

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Explanatory notes in Chapter 1

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Site 398 Hole D

Core 79 Cored Interval:

1183 - 1192.5

AGE	FAUNA ZONE	FOSSIL CHARACTER	SECTION				LITHOLOGIC DESCRIPTION	
			METERS	LITHOLOGY	LITHO. SAMPLE	SED. STRUCTURES		
			0					
			0.5					
			1					
			1.0					
			2					
			3					
			4					
			5					
			6					
				Core Catcher				

Units, symbols as in previous cores

folded; with tight olive gray dolomitic clasts, some with apparent inclusions; composite aggregates?

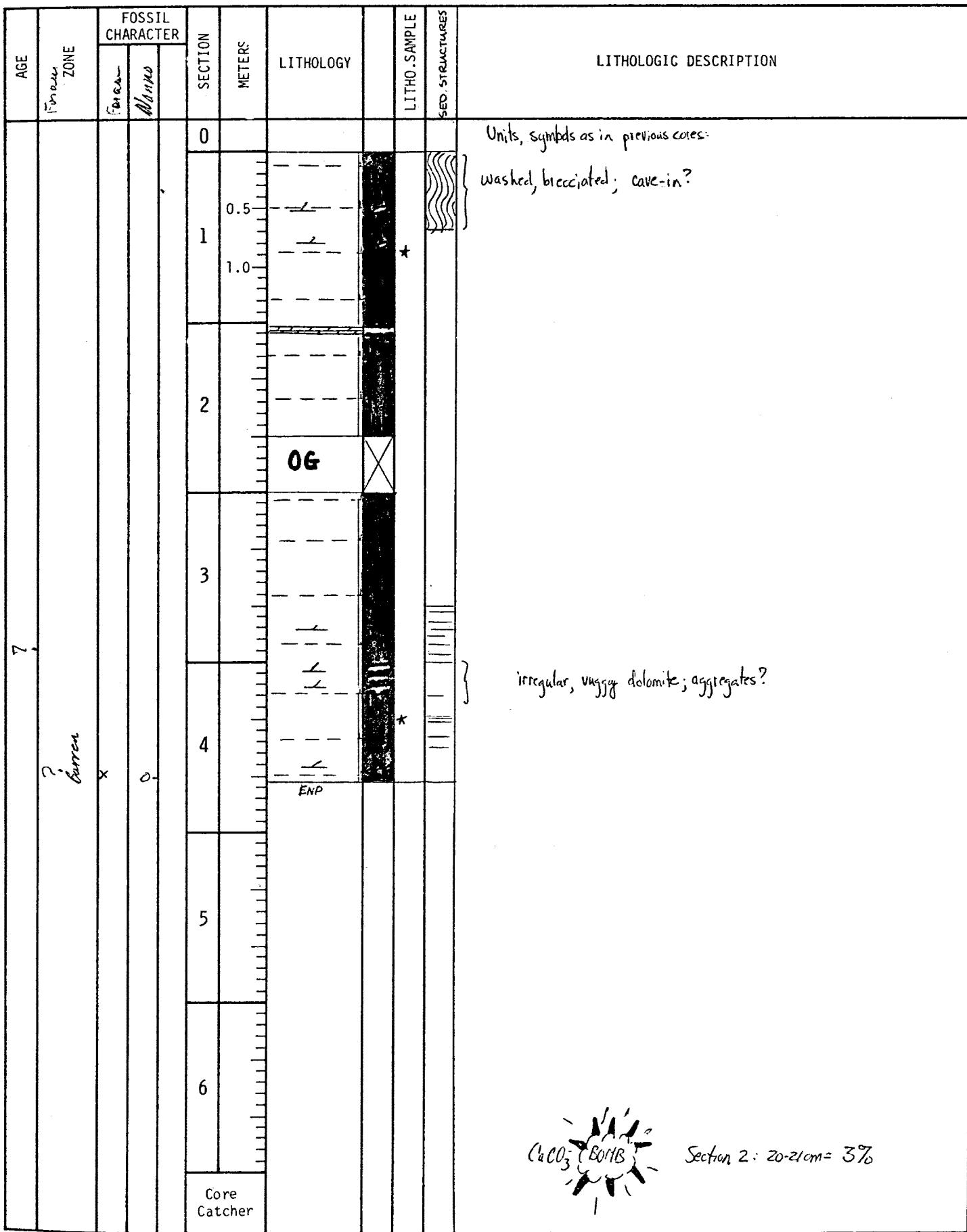
several well-preserved shells, apparently with original shell-peacock play of colors; corrugated in cross-section; *Inoceramus*?

136

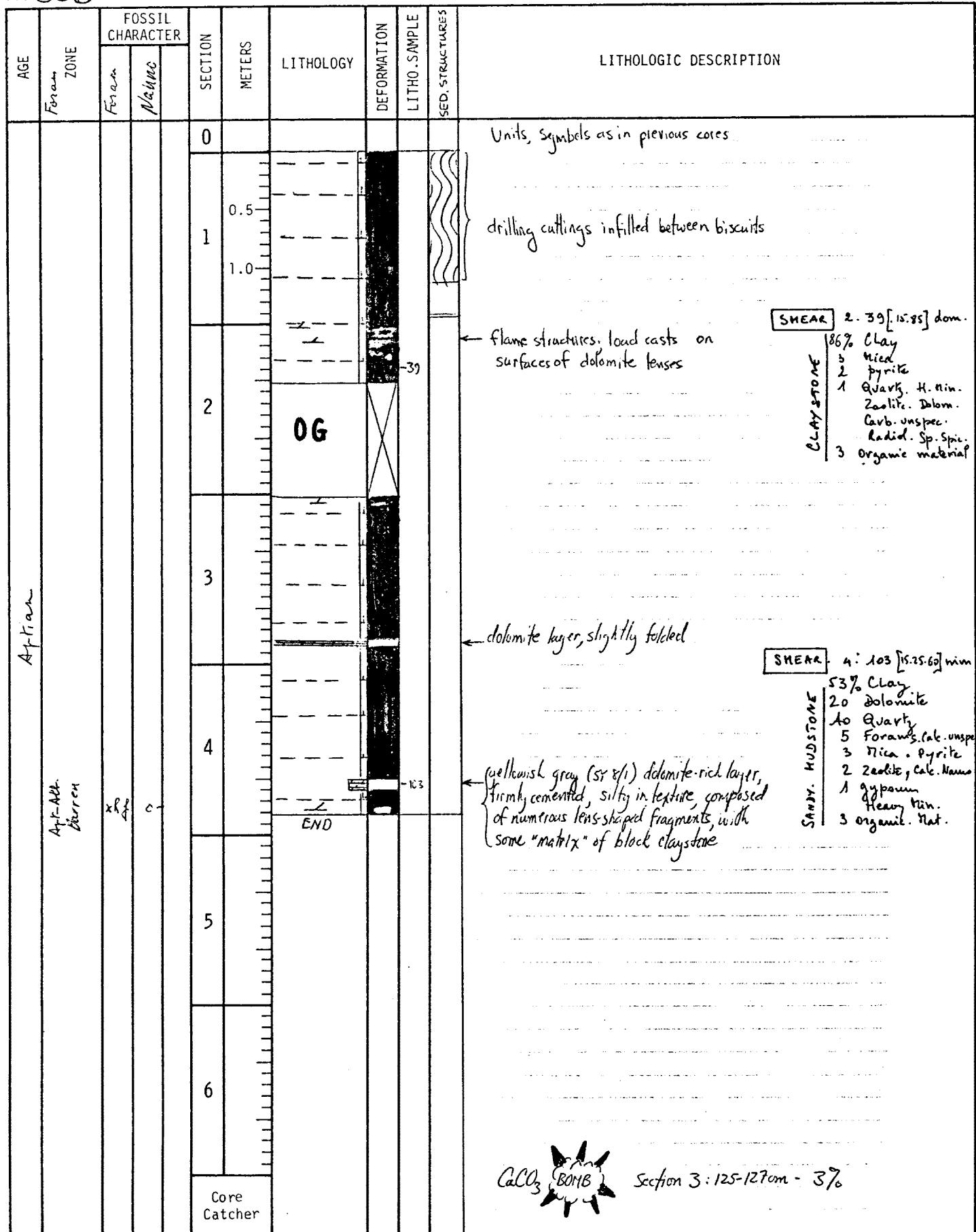
SHEAR	3.1 [25.25] down black.
CLAY STONE	71% clay 5 Quartz Carb. unspecified 4 Dolomite 7 Icosa 3 H. Min. 2 Calc. Nodules 1 Pyrite. Zeolite.

$\text{CaCO}_3$  BOMB 23  
Section 2: 45cm = 7%

Site 398 Hole D Core 80 Cored Interval: 1192.5 - 1202.0



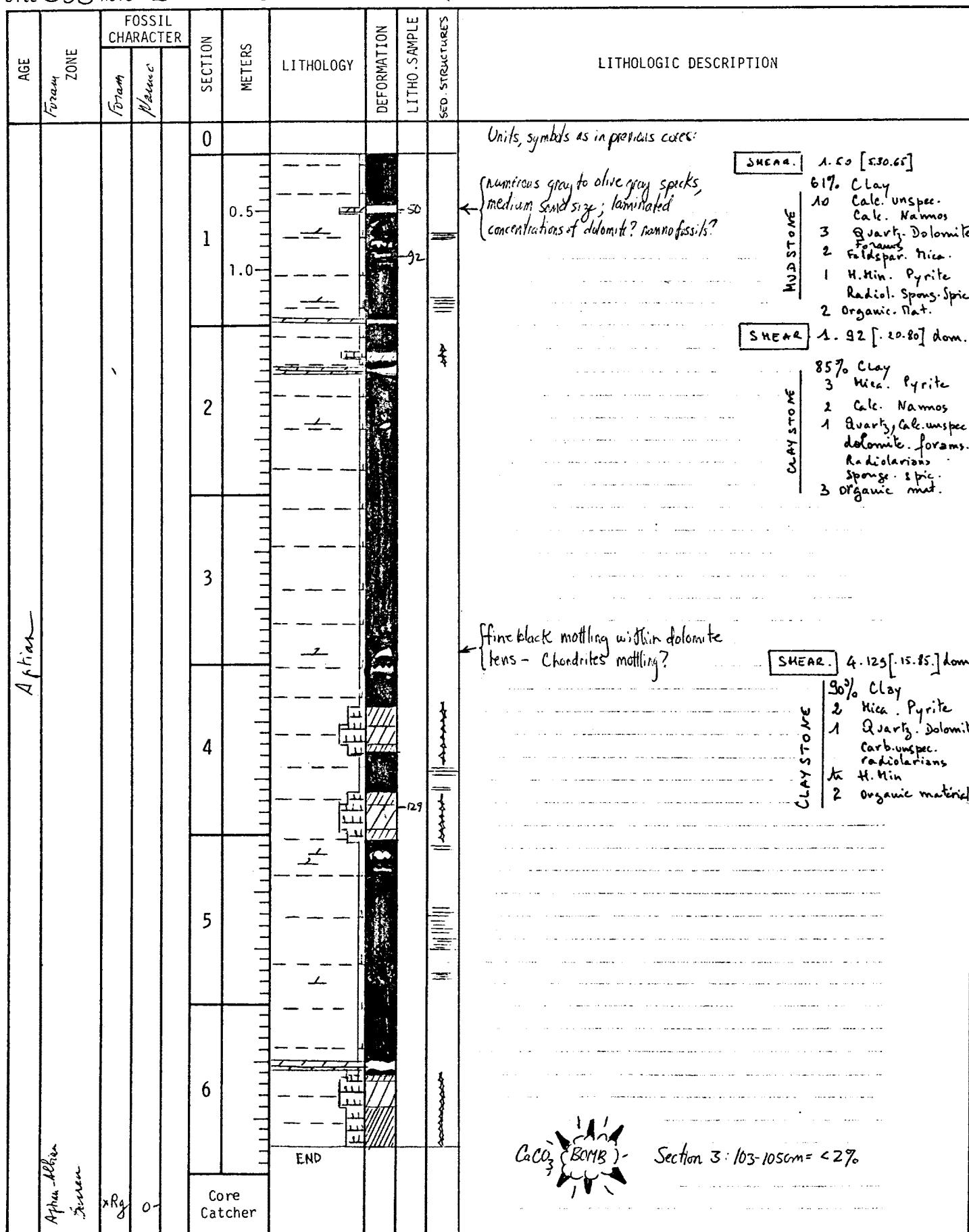
## Explanatory notes in Chapter 1



site 398 Hole D

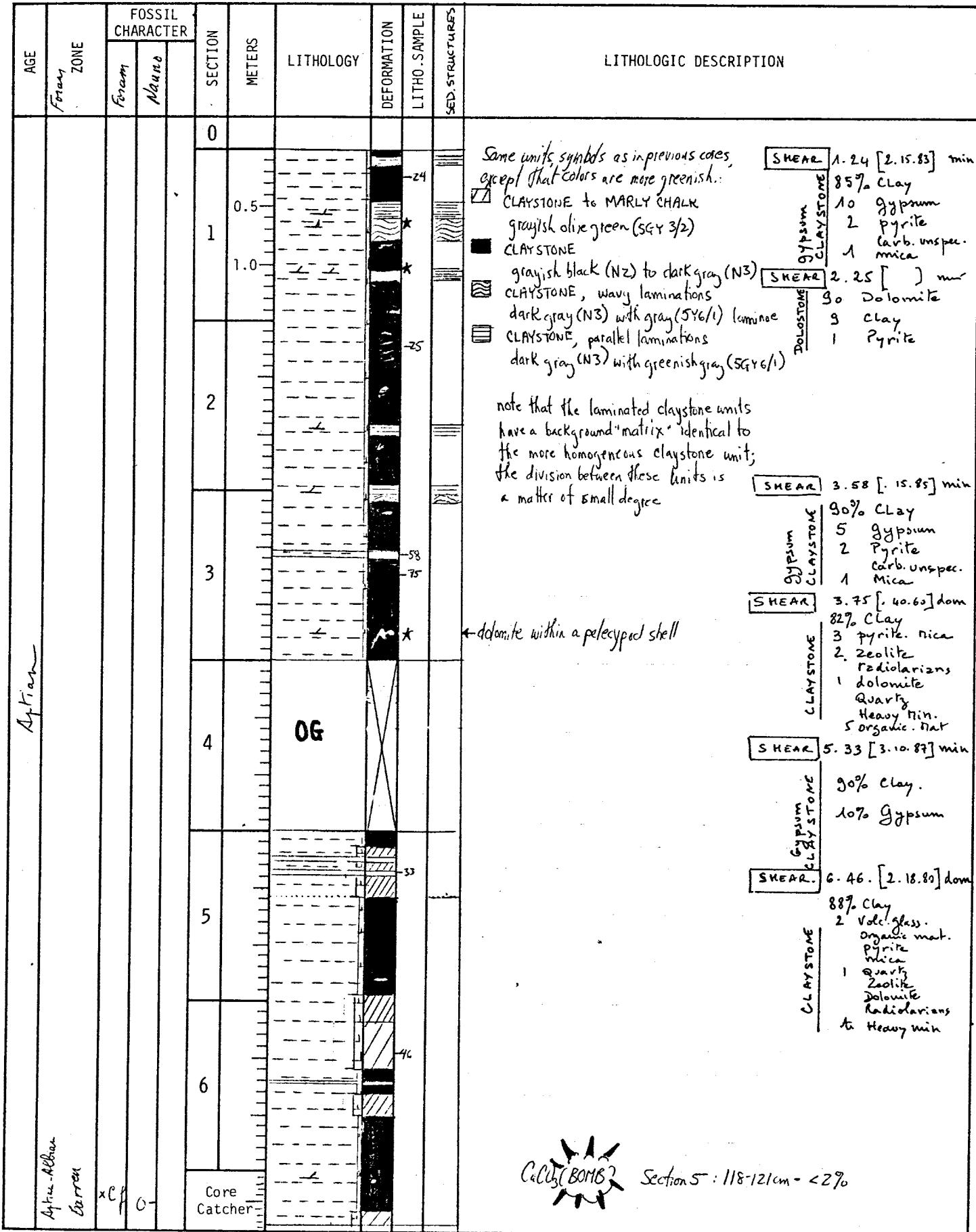
Core 82 Cored Interval: (5111.5 - 5121.0)

1211.5 - 1221.0 m



Explanatory notes in Chapter 1

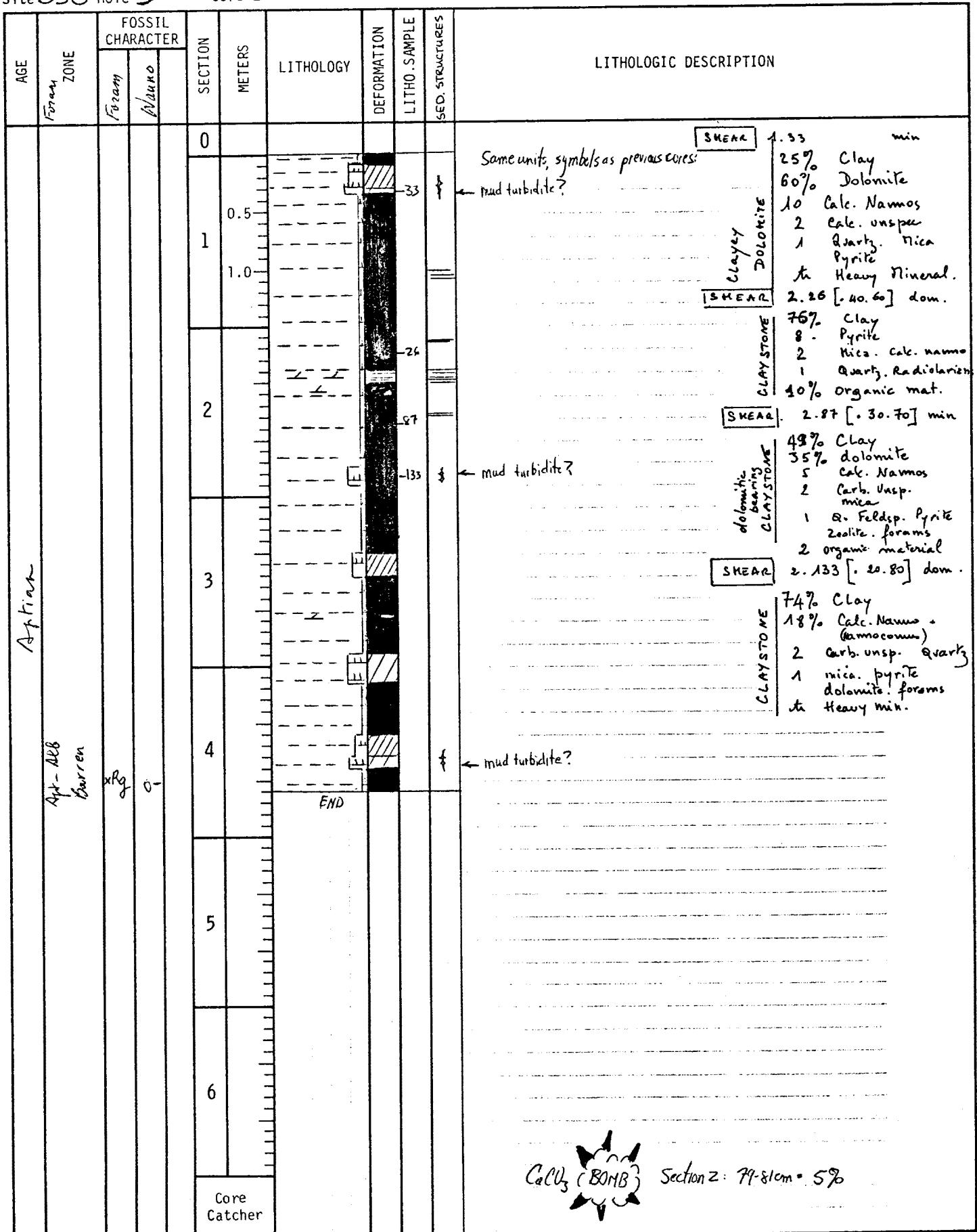


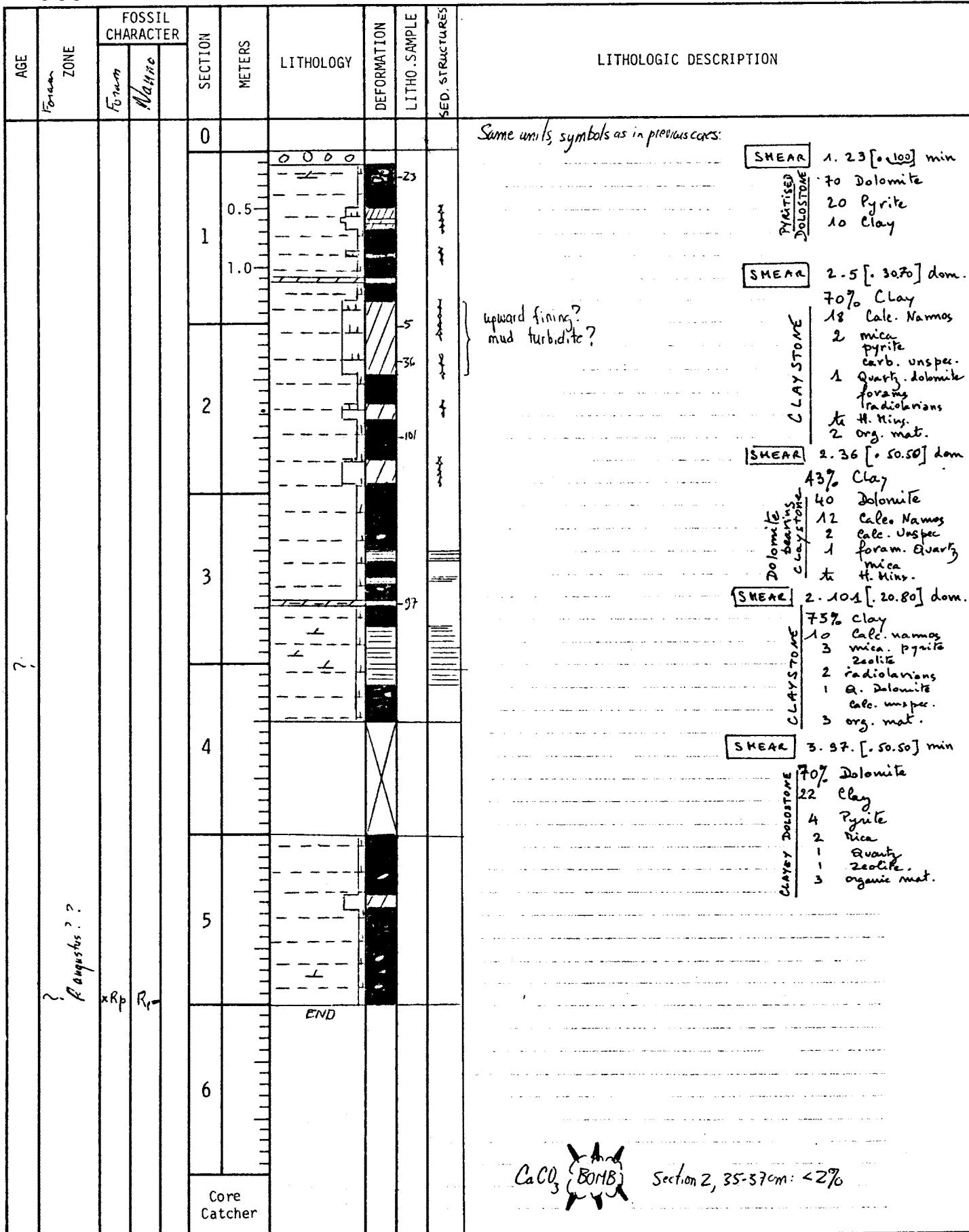


Section 5: 118-121 cm - <2%

Site 398 Hole ①

Core 85 Cored Interval: 1240. - 1249.5





Site 398 Hole D

Core 87

Cored Interval: 1259 - 1268.5

LITHOLOGIC DESCRIPTION

AGE	Foram ZONE	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		SED. STRUCTURES
							Foram	Planum	
?	barren			0					
?	xRf			0.5					
				1					
				1.0					
				2					
				3					
				4					
				5					
				6					
					END				
					Core Catcher				

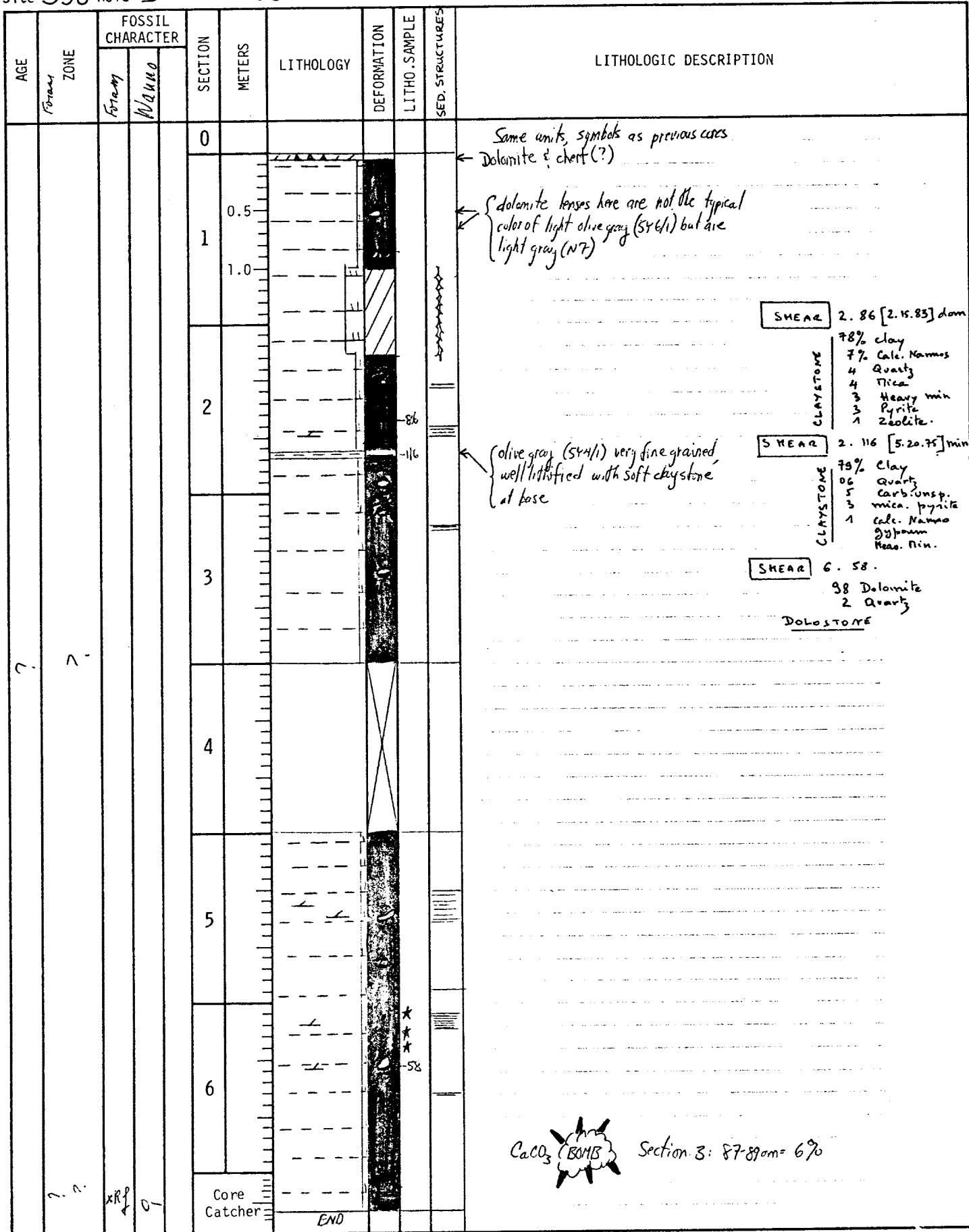
Same units, symbols as in previous cores  
→ mud turbidite?

→ mud turbidite?

$\text{CaCO}_3$  BOMB Section 1, 28-30cm. <2%

## Explanatory notes in Chapter 1

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Explanatory notes in Chapter 1





AGE	FORAM ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFOR.	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Foram	W. Index								
?				0						Units symbols as in previous cores	
				1	0.5					SHEAR 2.16 [ ]	
				1	1.0					DOLOSTONE	
				2						medium gray (N5) claystone	
				3						SHEAR 3.91 [10.5] min	
				4						73% Clay 5 Carb. unsp. 4 dolomite 3 quartz 3 calc. narmos 2 mica 1 Heavy min zeolite to fibers 3 organic mat.	
				5						CLAYSTONE	
				6						4.130 [10.50] dom	
										78 clay 10 Quartz 4 silica 3 Heavy Min. 2 pyrite 1 Radiolarians 2 organic mat.	
										CLAYSTONE	
										olive black (SY2/1) w. th. laminations of light olive gray (SY6/1) as in the grayish black interval, but much more indurated; does not expand like the other claystones dark gray (N4) claystone	
										CaCO <sub>3</sub> (BOMB)	
										Section 4: 101-102: <2%	
										Core Catcher	

### Explanatory notes in Chapter 1

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Site 398 Hole D

Core 92 Cored Interval: 1306.5 - 1316.0

Core 93 Cored Interval: 1316 - 1325,5 m

AGE EPOCH ZONE	Fossil character	Section	Meters	Lithology	Deformation	Litho. sample	Sed. structures	Lithologic Description	
								Units	Thickness
		0						Units, symbols as in previous cores.	
		1	0.5					SHEAR [2.25-73] down.	
		2	1.0					83 Clay 3 Pyrite 2 Quartz, Mica, radiolarians 1 Volc. glass. Zeolite dolomite 5 Org. mat.	
		3	2					SHEAR [2.20-80] min.	
		4	3					9A Dolomite 5 Clay 1 Pyrite	
		5	4					SHEAR [50.30-25] min.	
		6	5					70% Dolomite 22 Clay 1 Q. Mica. Volc. glass. Pyrite, Zeolite etc Radiolarian (pyritized) 3 organic mat.	
		END						SHEAR [2.40-58] min.	
								60% Clay 8 Dolomite. Pyrite carb. unspec. 5 Zeolite 3 Calc. Nannos 2 Mica 1 Quartz 5. Org. mat.	
								SHEAR [25.50-25] min	
								70 Dolomite 25 Clay 3 organic mat 1 Volc. Glass Pyrite	
								Section Z: 47-49cm: 3%	
								BRECCIA (H. filling) $\text{CaCO}_3$ (BOMB)	

Geological notes in Chapter 1



Site 398 Hole D Core 95 Cored Interval: 1327.5 - 1335 m.

Site 398 Hole D

Core 96 Cored Interval: 1335.0 - 1344.5

AGE	FORAM ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		FORAM	PLACOSTR.							SKEAR	1. 6.8 [60.40] min (clast) 55% Carb unspec. 20 Dolomite 20 Clay 5 Pyrite
Barronian - Aptian	Barten			0						SKEAR	1. 7.3 [40.60] dom. 67% Clay 10 Carb. unspec. 3 Calc. Narmas pyrite
				0.5							2 Quartz 10ka Volc. glass Zeolite Heavy Rims. Dolomite forams. Radiol. 5 organic mat.
				1	0.5						
				1	1.0						
				2							
				2							
				3							
				3							
				4							
				4							
				5							
				5							
				END							
				6							
				6							
				Core Catcher							
		xRF									

Units, symbols as in previous cores

dolomite nodule with very smooth, straight hole through center - bore hole? weathered?

hard rounded clasts of dark olive gray in a soft matrix of very dark gray; ammonite shell fragments, dolomite breccia in calcite cement?

$\text{Ca CO}_3$  80MB 1, 6-7, 9%

Explanatory notes in Chapter 1

Site 398 Hole D Core 97 Cored Interval: 1344.5 - 1354 m.

## Explanatory notes in Chapter 1

site 398 Hole D Core 98 Cored Interval: 1354 - 1363.5 m

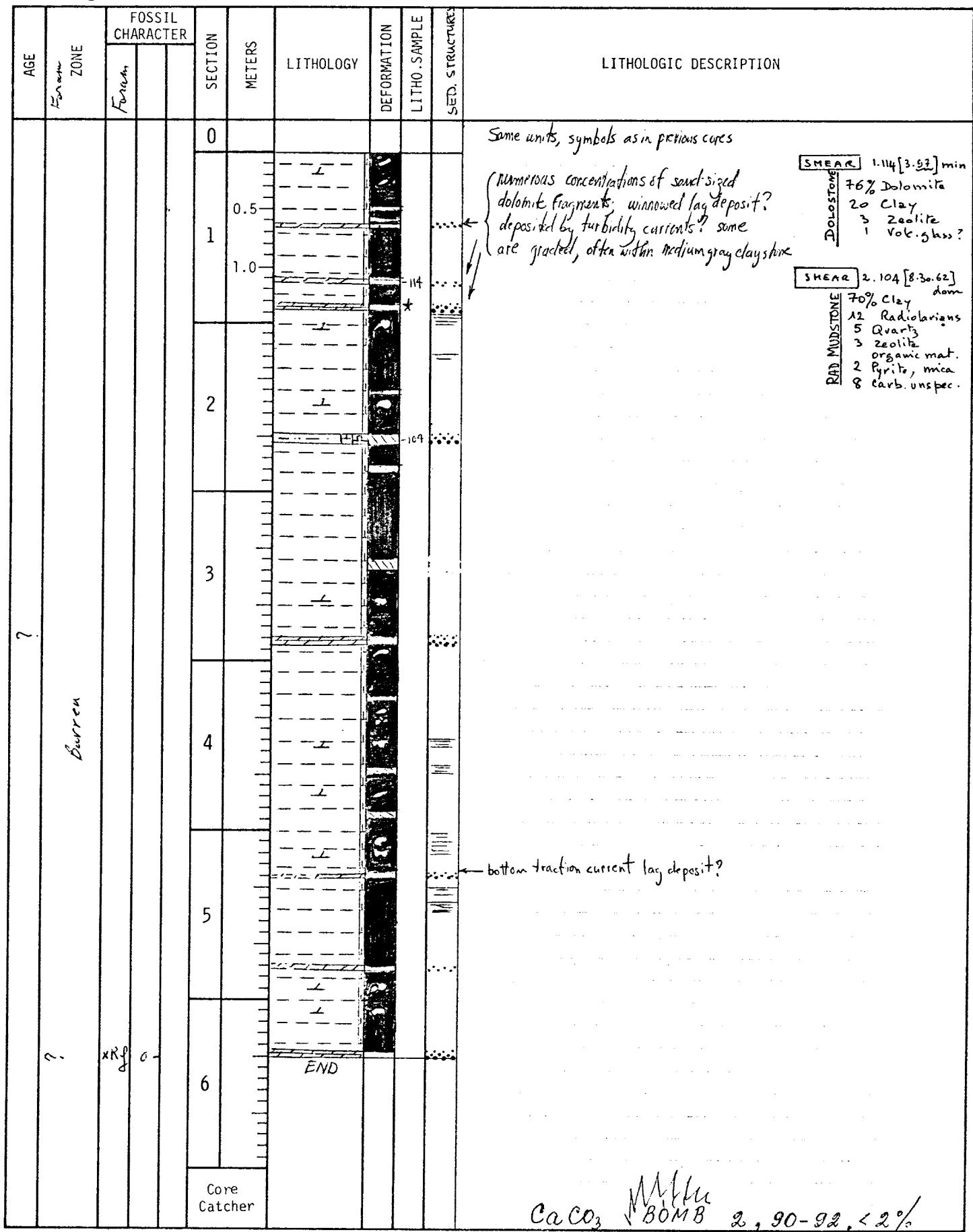
AGE	ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Fossil	Mineral								
				0							
				1	0.5			41	washed, brecciated	SHEAR	1. 41 [± 100] min 98 Dolomite 1 pyrite 1 zeolite
				1	1.0			98 104		DOLOSTONE	1. 98 [8.42.50] min
				2				36	Similar to previous cores, but light olive gray laminae are virtually absent; dolomite is very rarely in thick homogeneous beds; irregular, vuggy fragments generally ¼ to 2 cm in greatest dimension are common; ammonite shells are absent	MUDSTONE	62. Clay 10. Carb. unspec. 5. Quartz Radiolarians 3 Hica. Pyrite 2 Heavy Min. Calc. Nanno 1 Feldspar Sponge spic Volc. Glass? 5 organic mat.
		x Cf. W.		2		END			dolomite breccia, no matrix	SHEAR	1. 104 [5. 95] dom. 75% Clay 3 Hica. Radiol. Pyrite 2 Volc. glass Zeolite 1 Q. Dolomite Heavy. Min. 5 Organic. mat.
				3						CLAYSTONE	2. 36 min
				4						DOLOSTONE	
				5							
				6							
				Core Catcher							

CaCO<sub>3</sub> V BOMB 1,80-82, <2%

### Explanatory notes in Chapter 1

Site 398 Hole D

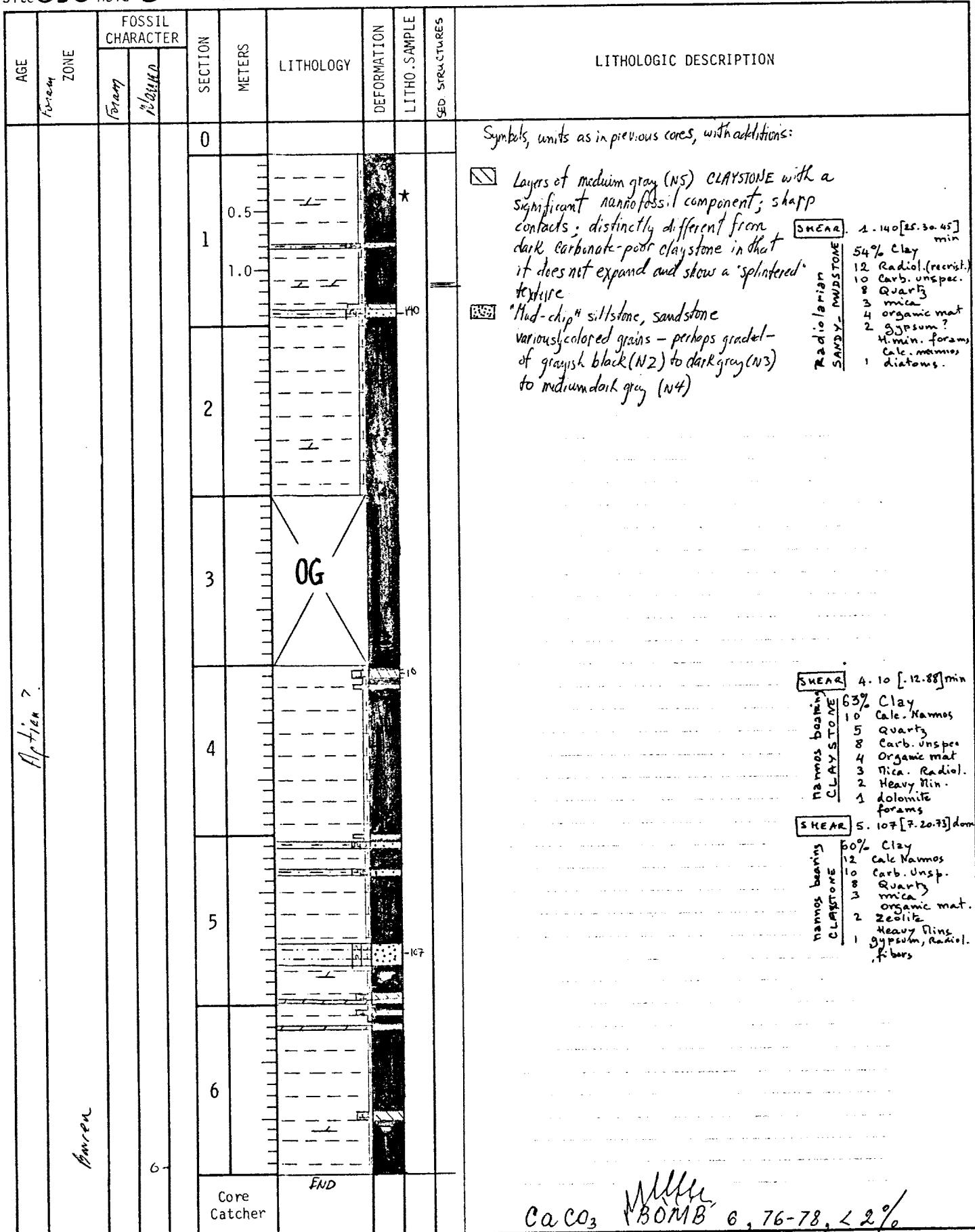
Core 100 Cored Interval: 1373 - 1382.5 m



Explanatory notes in Chapter 1

Site 398 Hole D

Core 101 Cored Interval: 1382.5 - 1392 m.



Explanatory notes in Chapter 1

AGE	Foram. ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Foram	Algae								
?	Burden			0							
					0.5						
				1	1.0						
				2							
				3							
				4							
				5							
				6							
	xRF			END							
				Core Catcher							

Units, symbols as in previous cores:

- SHEAR** 2.50 [1.15-84] dom  
 63% Clay  
 18% Calc. Namas  
 6 Org. mat.  
 5 Quartz  
 3 Mica  
 1 Heavy min.  
 Radiolarians (pyritized)  
 to dolomite
- SHEAR** 3.117 [0.20-80] min  
 68% Clay  
 10 Calc. Namas  
 7 Org. mat.  
 5 Quartz  
 Carb. unspec.  
 3 Mica  
 1 Heavy min. div.  
 1 apatite  
 to dolomite
- SHEAR** 3.118 [ ] min  
 98% dolomite  
 2% chlorite  
 Some grains of dolomite appear as euhedra  
 dolomitized (62%)
- SHEAR** 4.33 [0-100] minor  
 100% Carb. unspec  
 Monocrystalline  
**LIMESTONE**
- SHEAR** 6.61 [5.15-80] min  
 (grey dark, finely laminated)  
**MUDSTONE**  
 56% clay  
 15 Quartz  
 7 Calc. Namas  
 6 Org. mat.  
 6 Carb. unspec  
 5 Mica  
 2 Radiolarians  
 1 Zeolite  
 Gypsum?

hard, irregular lens of slightly vuggy, burrowed (Chondrites) of yellowish olive; looks exactly like all other dolomite lenses, but smear slide shows micritic calcite

brown, granular, vuggy, burrowed dolomite

parallel laminated fine sand; well indurated

CaCO<sub>3</sub> ✓ BOMB 1, 95-96, < 2%

AGE	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
								Foram	Mollusc
Late Aptian late Apt.	late Aptian	0							
P. rugosus ?		1	0.5	very light gray (N8) extremely hard, very fine-grained dolomite layer with dendritic solution infillings, with calcite laminations			washed	SHEAR	1. 43 [..-10] min 99% dolomite 1 Heavy min
	xAg	2	1.0	(dark greenish gray (SG4-V1) grading towards greenish gray (SG4-V1) at center; burrowed with grayish black (N2); relatively carbonate-rich; exactly the same as burrowed intervals prior to core)				DOLOMITIC LIMESTONE	1. 44 [10-30-60] min 50% dolomite 30% Carb. unspec 16 Clay 3 org. mat. 1 Pyrite
	xRf	3		grained "mud-chip" sandstone; variegated colors - light and dark clays, black, green				SHEAR	2. 36 [5.28-57] min 52% Clay 12 Calc. Namnos 10 Carb. unspec 8 Quartz 6 radiolarizans(pgr) 5 org. mat. 3 mica 2 Heavy min. 2 Dolom. dolomite
	xRg	4					inclined laminae indicate drill is ~6° off vertical	NAMNO-CALCAREOUS MUDSTONE	2. 41 [35.30-35]
	xRg	5						NAMNO-CALCAREOUS MUDSTONE	45 Clay 20 Carb. unspec. 10 Calc. namnos 8 radiolarizans 6 Quartz 4 Mica organic. mat. 3 Pyrite
		6						SHEAR	5. 87 [2.30-68] dom 52 Clay 15 dolomite 15 Calc. Namnos 10 carb. unspec. 4 org. mat. 2 Quartz mica?
	xAg	Core Catcher		OG				DOLO-NAMNO MUDSTONE	6. 64 [2.35-63] min 52% Clay 18 Dolomite 18 Calc. Namnos 5 Carb. unspec. 3 Quartz
		END							

## Explanatory notes in Chapter 1

AGE	FORAM. ZONE	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
									Nann.	
Late Aphaia.			0							
Late Aphaia.			1	0.5	finely laminated marly limestone to limestone - medium gray (N5) to bluish white (BBV1) with very white rounded grains of granite-sized nanno chalk folded towards base, discordant, asymmetric / brittle fracture	-93			SHEAR	1. 93 [- 100] dom 23% Clay 70% Calc. Nanno. (mostly recrystallized) 5 Carb. unspec. 1 dolomite 1 pyrite.
			1	1.0	scattered pyrite crystals, granite-sized dewatering veins slightly greenish gray in color oolitic texture in lightest intervals	-22			SHEAR	2. 22 [- 100] dom 75% Calc. Nanno (recrystallized) 17% Clay 5 Carb. Unspec. 2 Zeolite 1 mica
			2		olive black marly chalk	-40			SHEAR	2. 40 [5. 50.50] dom 47% Clay 40% Calc. Nanno 3 Zeolite 2 Pyrite 1 dolomite, mica Quartz 2 Org. mat.
			3		brittle fractures	-65			SHEAR	3. 65 [clast] NANNO LIMESTONE
			3		(pelagic section, very dark gray (N2) to dark greenish gray, laminated, burrowed) laminated gray limestones with rounded nanno chalk granules	-102			SHEAR	3. 85 [5.10.85] min 30% Clay 8 Gypsum 2 Quartz
			4		pelagic, as above				SHEAR	3. 102 [- 20.80] dom 84% Clay 5 Org. mat. 3 Quartz 2 Pyrite 2 Zeolite 1 Mica Heavy Min.
			5							
			6							
			Core Catcher							

Explanatory notes in Chapter 1

Ca CO<sub>3</sub> NANO  
NBOMB 2, 105-107, 84%

Site 398 Hole D

Core 106 Cored Interval: 1430 - 1439.5 m.

AGE	FORAM ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Forams	Macrofauna								
?	Baeren			0						Several debris flows at top of core with intervening homogeneous marly chalk, burrowed pelagic sediment towards bottom of core	
				0.5							
				1							
				1.0							
				2							
				3							
				4							
				5							
				OG							
				6							
				END							
				Core Catcher							

$\text{CaCO}_3$  M1/M2  
130 MB 2, 94-96, 31%

Explanatory notes in Chapter 1



site 398 Hole D

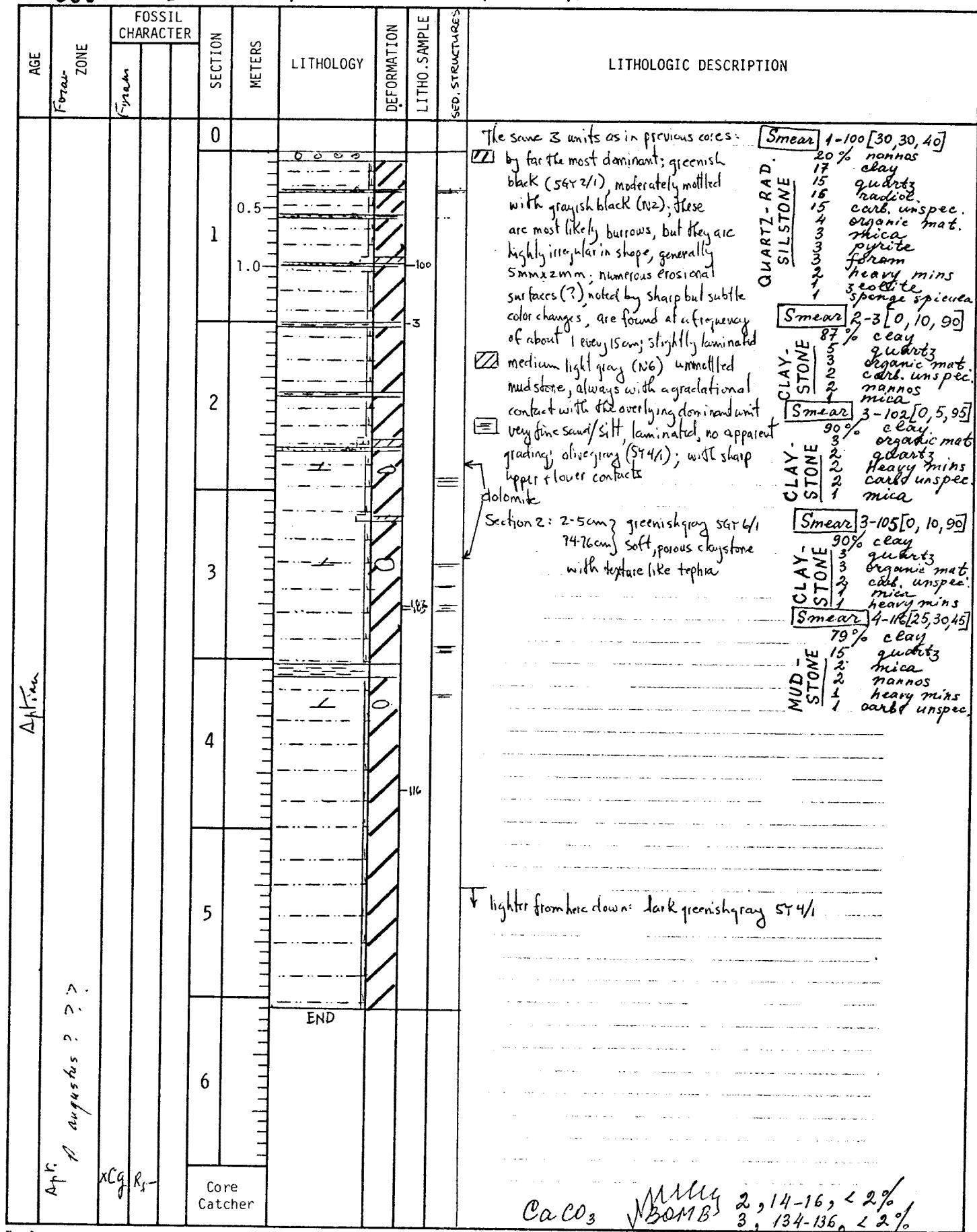
Core 108 Cored Interval: 1449 - 1458.5 m.

Site 398 Hole D Core 109 Cored Interval: 1458.5 - 1468 m

Site 398 Hole D Core 110 Cored Interval: 1468-1477.5 m

AGE	ZONE	FOSSIL CHARACTER	SECTION	LITHOLOGY	LITHOLOGIC DESCRIPTION
					Breccia only, variegated mudstones medium gray to light gray, N3-N6
				END	LITHO. SAMPLE
					DEFORMATION

Site 398 Hole D Core // Cored Interval: 1477.5 - 1487.0





## Explanatory notes in Chapter 1

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### **Explanatory notes in Chapter 1**

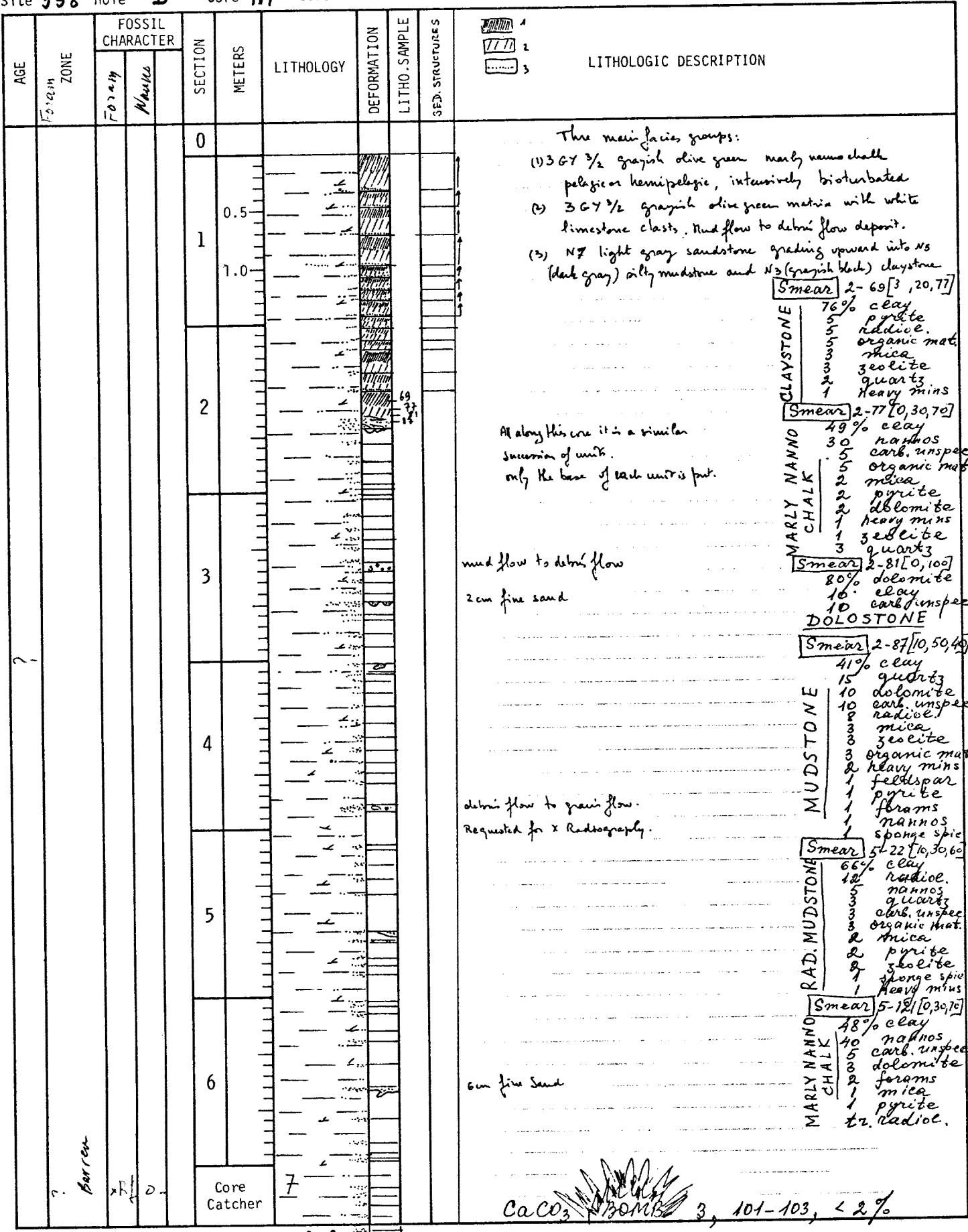
*Mme*  
CaCO<sub>3</sub> MB 4, 102-103, 12%

Site 398 Hole D Core 115 Cored Interval: 1515.5 - 1525.0

### Explanatory notes in Chapter 1

Site 398 Hole D Core 116 Cored Interval: 1525.0 - 1534.5

Explanatory notes in Chapter 1



AGE	From ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORmATION	LITHO.SAMPLE	SED.STRUCTURES	LITHOLOGIC DESCRIPTION	
		Fauna	Flora								
?	?			0							
				0.5							
				1							
				1.0							
				1.5							
				2							
				2.5							
				3							
				3.5							
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				4.5							
				5		OG SAMPLE					
				5.5							
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				9							
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				94.5	</td						

AGE	FOSSIL ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Fossil	Wanted								
?	Barren	x	o	0							
				1	0.5						
				2	1.0						
				3							
				4							
				5							
				6							
						Core Catcher					

Also similar to 117 and 118

Amalgamated silt to sand turbidite sequences

Base cut off Bouma sequences Td, Tt

No bioturbation

Some Tt (pelagic mud) units  
overbank deposit

Predominantly parallel laminated  
with fine to medium beds  
(1-5 cm thick)

Only are report the base of sequences.  
Set 2 Requested for X-ray.

CLAYSTONE  
Smear 2-68 [2, 30, 68]  
72% clay  
18 quartz  
3 pyrite  
2 mica  
2 carb. unspc  
2 organic mat  
1 heavy mins.

Rad.-calcareous  
SILTSTONE  
Smear 2-71 [30, 30, 40]  
30% carb. unspc  
18 clay  
18 radic.  
15 quartz  
5 dolomite  
3 mica  
3 organic mat  
2 fannos  
7 heavy mins.

LIME-STONE  
Smear 3-122 [5, 30, 65]  
60% carb. unspc  
27% clay  
5 quartz  
8 dolomite

NANAL  
CHAL  
Smear 5-138 [2, 25, 73]  
30% carb. unspc  
30 fannos  
15 dolomite  
18 clay  
5 quartz  
2 zeolite

fine sand ...  
silty mud ...

coarse quartz sandstone

Coarse clear sand

END OF CORE

$\text{CaCO}_3$  111  
BOMBS 2, 45-47, < 2%





AGE	Foram ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Forams	Planaria								
Barren	?	?	Barren	0							
M. hochstetteri Zone.	x	Rf		0.5							
	x	Rx		1							
				1.0							
				2							
				3							
				4							
				5		O G SAMPLE					
				6							
			Core Catcher	7							
Explanatory notes in Chapter 1		Core Catcher		1							
CaCO <sub>3</sub> Mer. 4, 25-26, 28 BOMB 4, 27-28, 33 4, 82-84, 25											

AGE	FORAM ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	SED.STRUCTURES	LITHOLOGIC DESCRIPTION	
		Forams	Molluscs								
?	M. hololeptica/2,1'	X	R <sub>4</sub>	0						Same turbidite sequences as in cores 122, 121, 120.	
				1	0.5					largely gray to mid gray to mid dark gray(s) units again greenish as always, with 2+3 as noted at center of about 20 additional (1) intervals, some graded. intervals darker towards upper lower contacts.	
				2	1.0					~ 20 intervals of (1) + the (2)'s + (3)'s as noted.	
				3						<b>Smear</b> 2-73 [20,40,40] 41% clay 15 quartz 15 nanno 5 zeolite carb.unspec mica dolomite radiol. organic mat feldspar 2 pyrite 2 heavy mins 1 forams	
				4						<b>MUDSTONE</b> <b>Smear</b> 3-98 [3,27,70] 58% clay 30 nanno 5 carb.unspec 3 radiol. 2 zeolite 1 quartz 1 mica	
				5						<b>Smear</b> 4-2 [0,40,60] 57% clay 26 nanno 5 zeolite 5 carb.unspec 3 organic mat 1 quartz 1 mica 1 pyrite 1 dolomite	
				6						<b>Smear</b> 4-10 [3,30,67] 50% clay 28 nanno 15 carb.unspec 2 organic mat 1 quartz 1 mica 1 pyrite 1 zeolite 1 dolomite	
										<b>Smear</b> 4-11 [3,31,60] 47% clay 26 nanno 5 pyrite 5 radiol. 3 zeolite 3 carb.unspec 1 quartz 1 mica 1 dolomite 1 heavy mins	
										Bottom of core	
										CalCO <sub>3</sub> NANO MBS 3, 85-86, 52%	

Explanatory notes in Chapter 1

Site 398 Hole D Core 124 Cored Interval: 1601.5-1610.5

### Explanatory notes in Chapter 1

AGE	Foram ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
		Foram	Foram								
				0							
				0.5							
				1							
				1.0							
				2							
				3							
				4							
				5							
				6							
				THE END							
				Core Catcher							

Explanations notes in Chapter 1

Three main facies associations:

- (1) mud-chip sand to silt size mudstone turbidites, with two main members (a) basal mud-chip sand and silt size light gray (N7) mudstone, which grades upward into (b) light olive gray mudstone (SY9a)
- (2) clastic-terrigenous quartzose sandstone to泥stone turbidites and channel sands. Well structured, rippled, laminar, graded bedding, etc.. Tabular terms
  - (a) coarse quartzose-micaceous sandstone
  - (b) carbonate bearing quartzose fine grain sandstone to siltstone
  - (c) medium dark gray (N7) MUDSTONE
- (3) dark-gray (N-3) homogeneous or slightly burrowed MUDSTONE

Only the main turbidite sequences are marked in the core log. The spaces not specified correspond to interlayering of mud turbidites and facies (3).

<b>Smear</b>	5-137 [15, 55, 3]
38%	clay
15	carb.unspec.
10	quartz
5	dolomite
5	mica
5	nannos
5	organic mat.
2	glauc.
2	pyrite
1	heavy mins.
1	feldspar
<b>Quartz-bearing SILTSTONE</b>	
<b>Smear</b>	6-71 [0, 60, 4]
47%	clay
15	organic mat.
10	quartz
10	nannos
5	carb. unspec.
3	mica
3	pyrite
2	feldspar
2	dolomite
2	glauc.
2	heavy mins.
1	feldspar
<b>MUDSTONE</b>	
<b>Smear</b>	6-74 [0, 10]
60%	nannos
28	clay
23	carb. unspec.
23	organic mat.
2	quartz
2	mica
1	dolomite
1	pyrite
1	heavy mins.
1	glauc.
<b>MUD NANNO CHALK</b>	
<b>Smear</b>	6-80 [5, 65, 30]
40%	nannos
20	clay
20	carb.unspec.
20	organic mat.
2	quartz
2	mica
1	dolomite
1	pyrite
1	heavy mins.
1	glauc.

Explanatory notes in C

## **Explanatory notes in Chapter 1**

### Explanatory notes in

AGE	ZONE	FOSSIL CHARACTER		LITHOLOGIC DESCRIPTION					
		MUD	CHALK	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES
Barremian - Late Hauterivian	1. belli:			0					
	R4-			0.5					
				1					
				1.0					
				2					
				3					
				4					
				5					
				6					
				OG					
				END					
		Core Catcher							

Site 398

Hole D

Core 131 Cored Interval: 1667.5-1677.0m

AGE		ZONE	FOSSIL CHARACTER		SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION			
			<i>M. venustus</i>	<i>M. venustus</i>										
Barremian - Late Hauterivian	<i>L. bollini</i>	Rp-			0						bluish white 58% marly nanno chalk light greenish gray (54%) marly nanno chalk	SMEAR	1-11 [0,30,70]	60% clay 35% nannos 3% carb unspec 1% quartz 1% mica
					0.5						below 23cm: Numerous intervals of mudstones and marly nanno chalks as described in previous core.	MARLY		
					1			END				NANNO CHALK	1-27 [0,20,80]	54% clay 35% nannos 5% organic mat. 3% carb unspec 1% quartz 1% mica 1% pyrite
					1.0									
					2									
					3									
					4									
					5									
					6									
							Core Catcher							

ite 398 Hole D Core 132 Cored Interval: 1677,0 - 1686,5

## **Explanatory notes in Chapter 1**

$\text{CaCO}_3$  ~~Mn~~ BOMB 3, 90-91, 55%

Site 398 Hole D Core 133 Cored Interval: 1686.5 - 1696.0

### Explanatory notes in Chapter 1

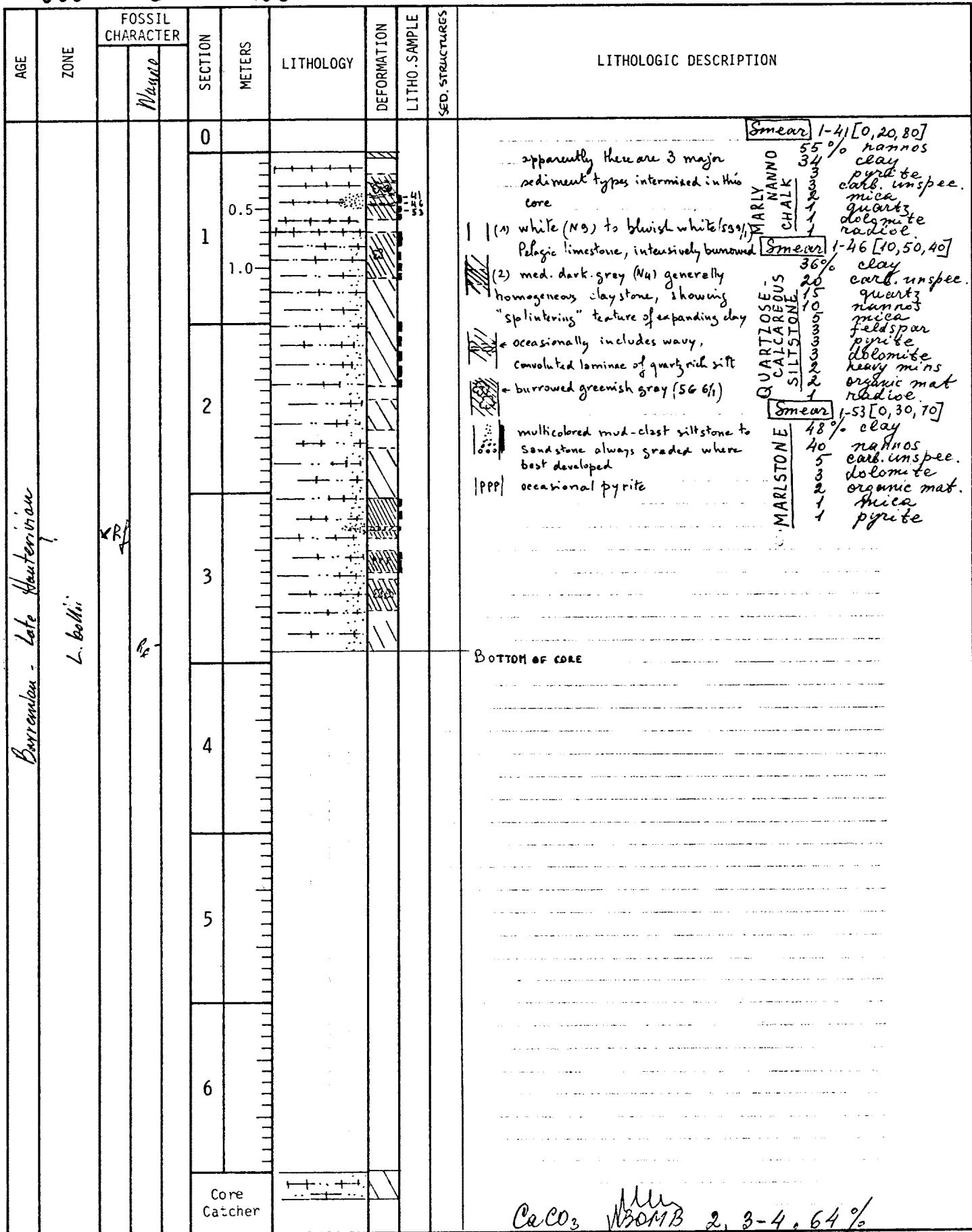
Site 398 Hole D Core 134 Cored Interval: 1696.0 - 1705.5

AGE	ZONE	FOSSIL CHARACTER	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES	LITHOLOGIC DESCRIPTION	
									Bottom Up	Top Down
Barremian - Late Hauterivian	L. bottii			0						
				0.5						
			1	1.0			112			
			2		(P)		21			
			3				54			weedy fragment
			4		END					
			5							
			6							
					Core Catcher					

CaCO<sub>3</sub> WSBM B 1, 77-78, 43%

Site 398 Hole D Core 135 Cored Interval: 1705.5 - 1715.0

## Explanatory notes in Chapter 1



Explanatory notes in Chapter 1

Site 398 Hole D Core 137 Cored Interval: 1724.5 - 1734.0

LITHOLOGIC DESCRIPTION

AGE	FOSSIL CHARACTER	ZONE	SECTION	METERS	LITHOLOGY		DEFORMATION	LITHO. SAMPLE	SED. STRUCTURES		
					Forams	Algae					
Harriman		Harriman Fm.		0							
—		Marine fac.		0.5							
L. bolivi	x Rf			1							
	x Cq			1.0							
	x Rf			2							
	x Rf			3							
	Rf			4							
	Rf			5							
	Rf			6							
			Core Catcher								

very similar to the previous core  
again 3 unit  
see last core for legend key.

**CALCAREOUS MUDSTONE** [Smear 1-98 [3, 37, 60]]  
 51% clay  
 25% marnos  
 20% carb. unspec.  
 1% quartz  
 1% mica  
 1% pyrite  
 1% dolomite

**LIME-STONE** [Smear 1-138 [0, 100]]  
 50% carb. unspec.  
 40% marnos  
 10% clay

**MARLSTONE** [Smear 3-106 [0, 30, 70]]  
 50% clay  
 30% marnos  
 3% carb. unspec.  
 5% organic mat.  
 3% pyrite  
 3% mica  
 1% quartz  
 1% heavy mins  
 1% zeolite  
 1% dolomite

**QUARTZOSE CALCAREOUS SILTSTONE** [Smear 3-145 [0, 60, 30]]  
 35% carb. unspec.  
 25% quartz  
 20% clay  
 5% marnos  
 4% dolomite  
 3% feldspar  
 3% mica  
 2% heavy mins  
 1% organic mat.  
 1% radice.

only these transitional intervals (between 1 & 2)  
with burrows, shows the expanding clay  
synchrone, perhaps the darkest intervals, III,  
are not our same organic rich expanding  
clays, but are very fine grained homogeneous  
unit 3's; but this is doubtful because of color;  
where wavy grained unit 3 is multicolored  
clay; perhaps when 3 interlaminated  
with 2, as it seems to do most of the time,  
the permeability + porosity is altered enough  
so that the mixture does not expand back  
at sea level.

## **Explanatory notes in Chapter 1**

164

AGE	ZONE	Fossil Character Plankton	Lithologic Description					
			SERCTION	METERS	LITHOLOGY	DEFORMATION	LITHO SAMPLE	SED. STRUCTURES
Barrowian - late Haasterian	L. bollii'	P	0					
			1	0.5				
			2	1.0				
			3					
			4					
			5					
			6					
		Core Catcher						

Rhythmic sedimentation as noted in previous cores  
This core is very similar in facies association to core 136.

i.e., a terrigenous (quartz mica)

structure laminae turbidites are not well represented

- mud chips turbidites are well show

- pelagic greenish-white burrowed limestone are well represented (58%)

- varve like, parallel laminated olivegray 57%

limestone are common but not abundant.

CalCO<sub>3</sub> N30MB 2, 116-117, 45%

all cuttings-

all cutting

END OF CORE

THE LAST CORE

END OF CRUISE